PICOMAX® 20

Operating and maintenance manual

Translation of the original operating manual

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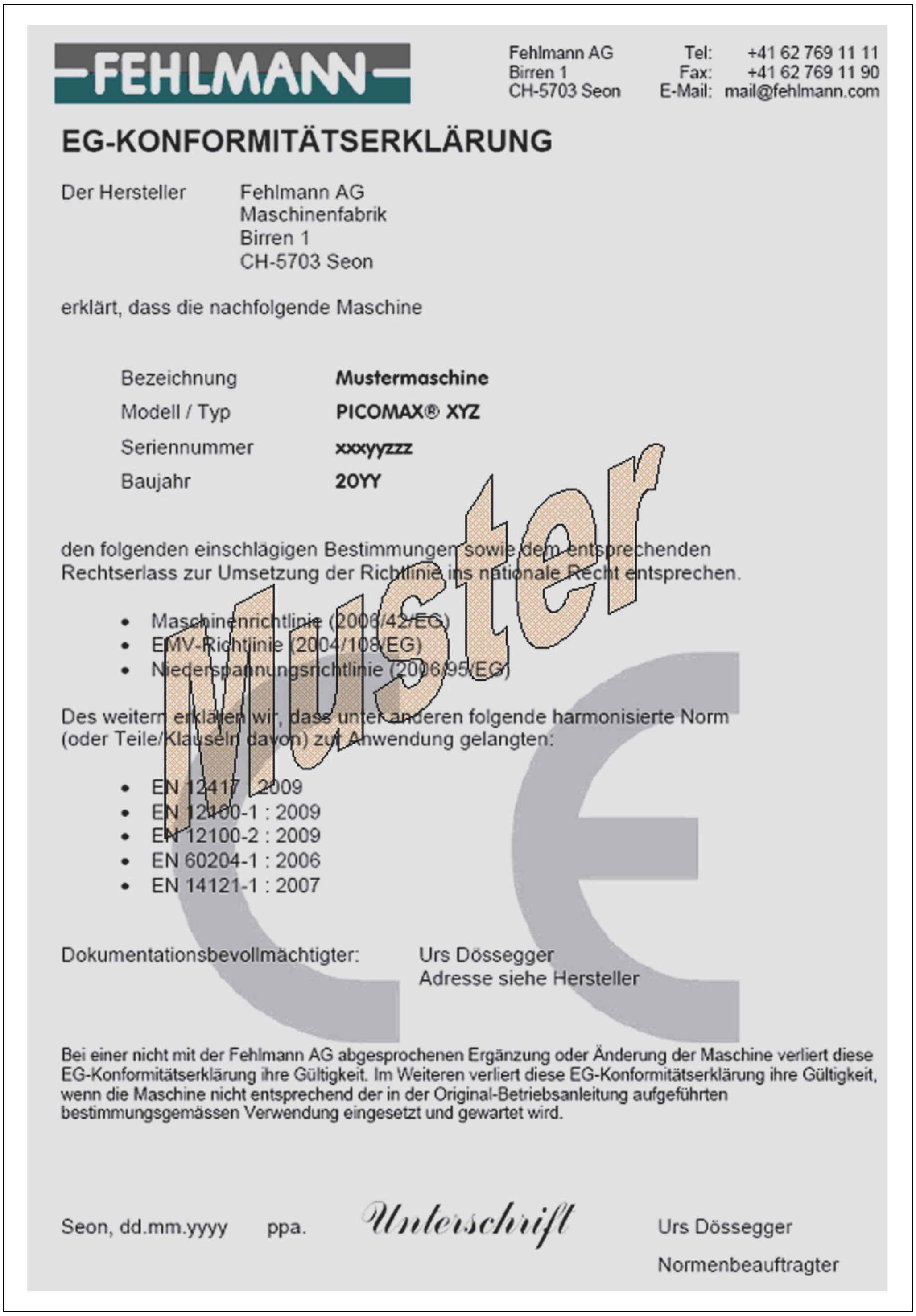
1 Introduction

1.1 Conformity declaration

For delivery, this page will be completed in the original operating instructions with the CE conformity declaration.



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EG-KONFORMITÄTSERKLÄRUNG

Der Hersteller
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erklärt, dass die nachfolgende Maschine

Bezeichnung	**Mustermaschine**
Modell / Typ	**PICOMAX® XYZ**
Seriennummer	**xxxyyzzz**
Baujahr	**20YY**

den folgenden einschlägigen Bestimmungen sowie dem entsprechenden Rechtserlass zur Umsetzung der Richtlinie ins nationale Recht entsprechen.

- Maschinenrichtlinie (2006/42/EG)
- EMV-Richtlinie (2004/108/EG)
- Niederspannungsrichtlinie (2006/95/EG)

Des weitern erklären wir, dass unter anderen folgende harmonisierte Norm (oder Teile/Klauseln davon) zur Anwendung gelangten:

- EN 12417 : 2009
- EN 12100-1 : 2009
- EN 12100-2 : 2009
- EN 60204-1 : 2006
- EN 14121-1 : 2007

Dokumentationsbevollmächtigter:
Urs Dössegger
Adresse siehe Hersteller

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Muster

1.2 General information

1.2.1 Manufacturer information

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Person in charge:
Urs Dössegger

1.2.2 Preface

The present operating and maintenance manual will help you to efficiently and safely use your new FEHLMANN product. On the following pages, you will get to know how to correctly

- transport,
- take into operation,
- operate
- and maintain your equipment.

☞ **Note!**

The only way to maintain the expected productivity and efficiency of the new FEHLMANN product is to carefully follow the safety, operating and maintenance instructions day by day.
FEHLMANN AG cannot be held liable for damage due to the disregard of the information and instructions in this operating and maintenance manual.
FEHLMANN AG refers you to the fact that all information and data in these operating and maintenance instructions may be changed without notice. Furthermore, FEHLMANN AG reserves the right of technical changes for product improvement.
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The operating and maintenance manual forms a unit together with the product and must always be available to the operating, service and control personnel at any time together with any programming and other manuals delivered with the equipment.

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The copyright of this operating and maintenance manual stays with FEHLMANN AG. The manual includes regulations and drawings of technical kind which may not be reproduced – neither fully nor partially –, spread or be used in an unauthorized way for competitive purposes or made available to third parties.

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The contents of the present operating manual have originally been compiled in the German language. Texts in other languages are translations of the German version and are identified as translation of the original operating manual on the cover page. Messrs. FEHLMANN AG do not assume any liability for translation errors. In case of uncertainties and contradictions, the contents of the "Original operating manual" will always apply.

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Only such defects are software defects which can be reproduced at any time. Concerning the warranty for software defects, the general warranty conditions by the FEHLMANN AG shall be valid. Repair will be made by the FEHLMANN AG at their choice either by installation of an improved software version, giving troubleshooting instructions or instructions for bypassing the effects of the defect.

1.2.6 Target groups and purpose of the operating and maintenance manual

Target groups

The present operating and maintenance manual is addressed to:

- the operating staff
- the programming staff
- the electric engineers
- as well as the service technicians

The following qualifications are required:

- completed mechanics training (or similar education)
- completed electro-engineer training (or similar education)

Additionally, it is assumed that the persons dispose of basic knowledge in the handling of machine tools.

Purpose of the operating and maintenance manual

The operating and maintenance manual shall put the various target groups in the position to safely and properly carry out all working steps. Therefore, the operating and maintenance manual must be read and understood by all persons charged with working at the FEHLMANN product.

1.2.7 Conception of the operating and maintenance manual

This operating and maintenance manual is structured in a way that it can be used in various ways depending on how many information are required.

It is recommended to reach through the entire operating and maintenance manual once as a kind of crash program. In this way, you will get a general idea on the configuration and the entire contents. Furthermore, you will be informed on the additional options offered. Finally, you will get first information on the urgency of maintenance and repair work.

For solving special tasks in day-to-day work, you will use the operating and maintenance manual as reference work using the table of contents or index.

This manual includes all information to operate, maintain and repair the product. It must therefore be granted that the entire personnel may access this documentation at any time.

It was not the intention of the author to create a merely theoretical work which is while FEHLMANN AG always welcomes improvement proposals and incentives increasing the quality of the manual.

1.3 General description of the machine tool

The PICOMAX® 20 is a handy coordinates drilling and milling machine of precision designed for a use in mechanical workshops and learning structures, in the general machine building, calibrating and device production, and tool making fields.

2 Safety instructions and precautions

2.1 Preface

FEHLMANN products are designed and built according to the latest state-of-the-art and inherently safe. However, the safe operation for man and machine requires the proper transport, due installation and commissioning as well as careful operation and service.

It is thus indispensable that every person charged with the transport, installation, commissioning, operation or service has carefully read and understood the present operating and maintenance manual and always observes the regulations and information contained therein for all operations and activities at the equipment!

FEHLMANN AG recommends the customer to set up internal instructions taking into consideration the known special qualification of the personnel employed and to have the reception of the operating and maintenance manual or the participation in training, education confirmed in writing.

2.2 Explanation of symbols and note

This operating manual includes notes and formation which must be observed without fail in order to grant the personal safety of employees and to avoid material damage.

STOP

Danger!

This symbol showing the signal word “Danger” warns against an imminent danger which may lead to serious bodily injury or even death.

Danger!

This symbol showing the signal word “Danger” warns against dangerous electrical voltage which may lead to serious bodily injury or even death.

Warning!

This symbol showing the signal word “Warning” points out to a potentially dangerous situation which may lead to bodily injury or serious material damage.

Caution!

This symbol showing the signal word “Caution” points out to a situation which may lead to material damage or malfunctions.

Note!

This symbol refers the user to advantageous applications or operations or to other useful information.

📖 **This symbol marks a literary reference.**

2.3 General safety regulations

The following general safety regulation shall be followed next to the general safety and accident prevention instructions:

- The owner of the machine tool and its accessory must ensure and, in certain cases, give proof of the fact that FEHLMANN products are only operated by trained and authorized staff! ***See paragraph 1.2.6 Target groups and purpose of the operating and maintenance manual.***
- The owner of the machine tool and its accessory is responsible for a sufficient floor space for the operating staff. It must be even, stable and skid proof to avoid risks of accident by stumbling or slipping.
- The owner of the machine tool and its accessory must observe the working environment factors, such as illumination and noise and climate.
- The owner of the machine tool and its accessory must clearly specify the area of responsibility of the staff concerning operation, maintenance and repair!
- The operating personnel is also held responsible for ensuring that no unauthorized persons work at FEHLMANN products.
- The operating personnel is obliged to immediately report any changes to machine tools and its accessory and options affecting the safety!
- The operating personnel is obliged to only operate the machine tool and its accessory and options in perfect condition!
- The operating personnel must guarantee the cleanliness and tidiness of the workplace at and around the machine tool by following the appropriate internal instructions and controls!
- Principally, no safety devices may be disassembled, bypassed or switched off!
- Any unauthorized manipulation/reconstruction and/or changes to the machine tool and/or its accessory and options are prohibited in order not to jeopardize the safety of man and machine!
- Depending on the local conditions and the machine application, the noise emissions of the machine at the machine location could exceed the permissible limits. Never remove any noise protection devices and wear personal ear protection if necessary! ***See paragraph 7.4 Noise emission.***
- The operating personnel must possess personal protective clothes and equipment consisting of safety glasses, work gloves and safety-conforming work clothes.

STOP **Danger!**

Additionally, to the general safety instructions in this chapter, all information and regulations in the other chapters also apply.

2.4 Disregard of safety instructions

FEHLMANN AG does not assume any liability out of, or associated with, the disregard or violation of instructions and information specified in the operating manual. This particularly applies to:

- Damage resulting from improper use or operating errors.
- Damage resulting from the disregard of safety-relevant information specified in the operating manual or on warning signs attached to the machine tool.
- Damage resulting from deficient or missing maintenance works.

See paragraph 1.2.2 Preface.

2.5 Additional safety instructions

Concerning safety aspects, FEHLMANN products are matched to the latest state-of-the-art. The high efficiency and economy of the machine tools and their accessory and options is granted through optimized safety features and handiness.

STOP **Danger!**

The user must ensure that only specially trained staff informed on all risks of chip removal processes work at FEHLMANN machines.

- Never come close to a rotating tool! Wait for the program end or actuate the appropriate safety facilities in cases of emergency!
- The work spindle may not be rotated without tool holder!
- Never stay in the danger zone of the machine tool during the operation unless the main switch is set to [0]!
- FEHLMANN machines reach extremely high spindle speeds. In case of large and/or long unbalanced tools, this may cause severe injuries. Make yourself acquainted with the cutting conditions of your tools before starting to work at the machine tool!
  FEHLMANN AG offers specially balanced tool holders for high speeds.
- In case of manual or automatic tool changes, always make sure that the correct tool holder is inserted!
- Always wear safety clothes! Gloves, sleeves, jewelry, hair or similar are a potential risk and make it caught in the machine tool, by tools or workpieces!
- Chips, fluids, splinters or other fragments may flow out of all be ejected from the machining area. Therefore, always wear safety glasses!
- Make sure that the workpieces and tools are correctly clamped to avoid any danger to life and limb even in cases of overload situations.
- Always use the integrated machine illumination!
- Never use the machine tool and its accessory and options on an explosive atmosphere!
- Always use the lubricants recommended by FEHLMANN AG. ***See paragraph 4.27 Lubricant comparison table.***
- Various plates indicating dangers have been mounted to the machine tool. The instructions or the notes on these plates must under all circumstances be adhered to.
- Plates that are dirty or worn must be replaced immediately. Appropriate plates can be obtained from the customer service of Messrs. FEHLMANN AG.

2.6 Machine-specific risks

2.6.1 Special machine operating modes

Operating the machine in the operating modes

- SET-UP/MANUAL
- TOOL CHANGE EMERGENCY OPERATION

holds certain risks and may thus only be carried out by appropriately trained and qualified personnel which is able to identify and judge the potential risks of chip removing machining processes.

2.6.2 Machine tools with 2-axis or 2/3-axis operation

Machine tools designed for the 2-axis or 2/3-axis operation allow access to drilling lever and tools during the operation. Therefore, all works must be executed with special care.

The operation of the machine tool in 2-axis or 2/3-axis mode is thus reserved to appropriately trained and qualified personnel which is able to identify and judge the potential risks of chip removing machining processes.

STOP **Danger!**

Never reach into the rotating tool.

Always wear safety glasses when working in the 2-axis or 2/3-axis mode.

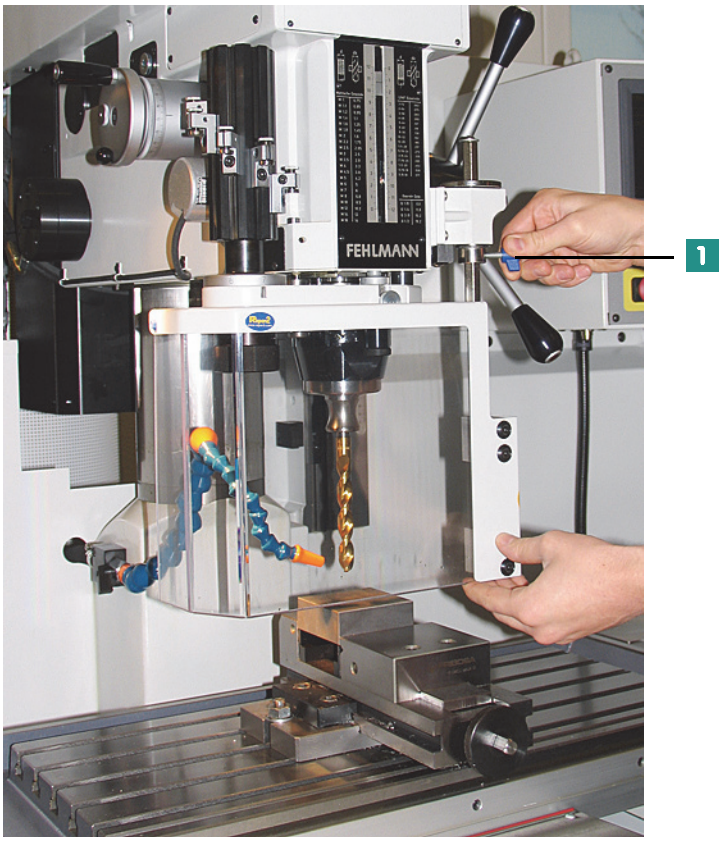
Never remove chips with your hands.

2.6.2.1 Safety device

The safety device is a height adjustable, electrically monitored safety disc.

Working with the safety device

1 Stop screw



Move machine head to working position

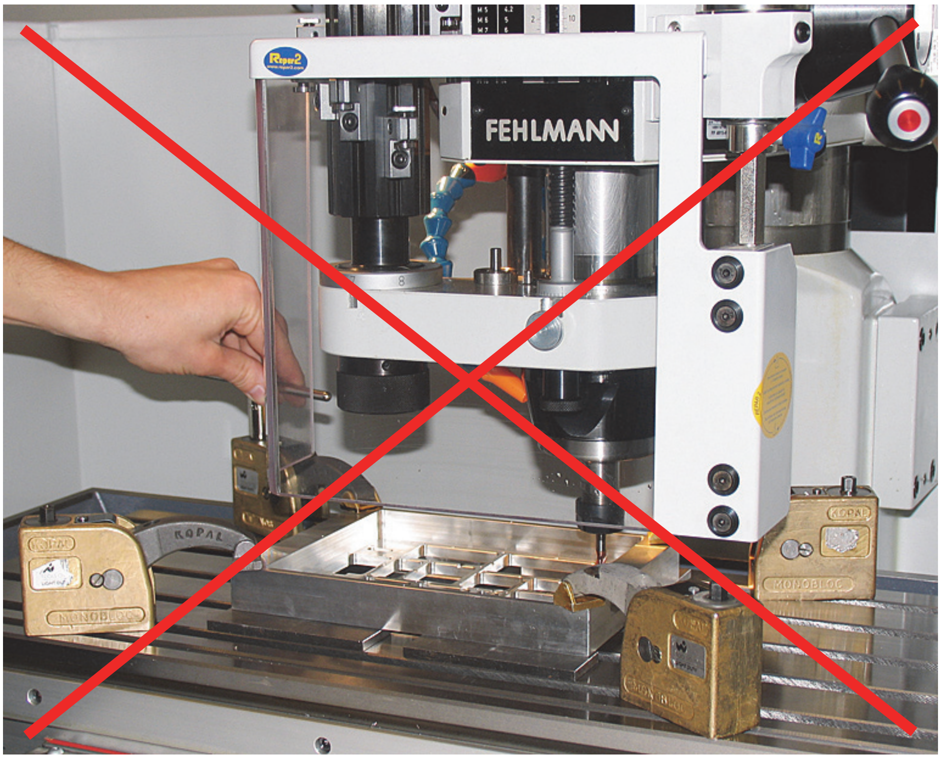
Adjust safety position in such a way that the lower edge is slightly (approx. 5 mm) above the work surface

Fix safety device using stop screw

STOP

Danger!

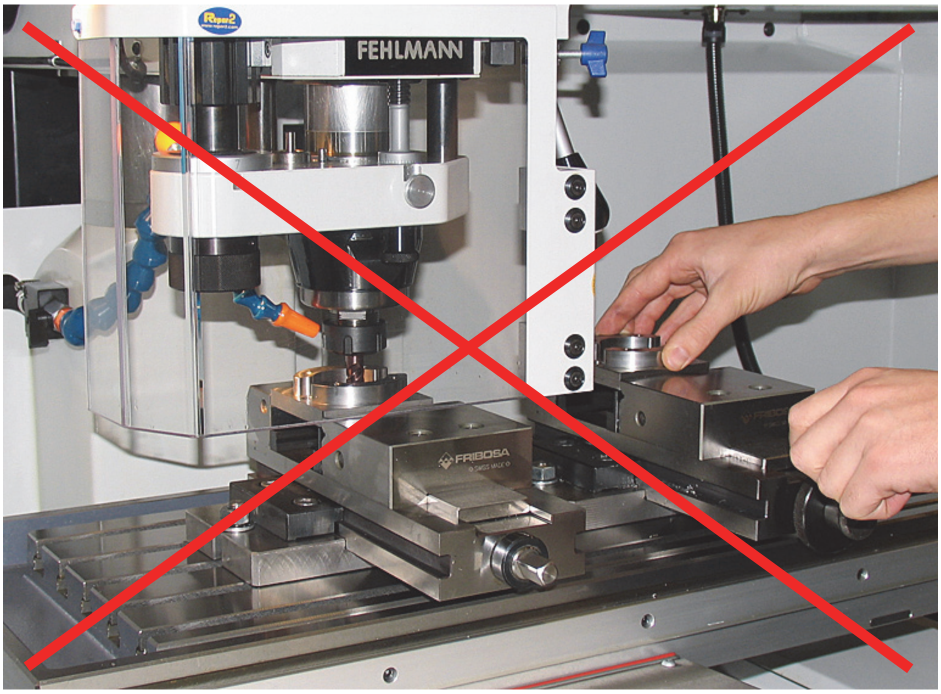
Never reach behind the safety device.



STOP

Danger!

Reciprocating machining is prohibited due to the danger of seizure or winding on.



2.7 Intended use

The FEHLMANN machine tool is exclusively designed for the drilling and milling of metallic and nonmetallic workpieces.

Any use and operation in excess of this is considered unintended. The manufacturer will not assume any liability resulting from such unintended use, and the risk will solely be born by the user in such cases.

Abrasive materials

The machine tool must not be employed in order to machine e.g.

- ceramic materials
- glass
- graphite

or similar materials.

For machining these materials, application-specific adaptations at the machine tool are necessary.

Caution!

Without the manufacturer’s consent, abrasive materials must not be machined.

Risk of explosion in the machine room

The machine tool must not be employed if, during the machining process,

- sparking occurs
- chemical reactions of non-explosive materials (e.g. magnesium) with the coolant or with the cooling lubricant can result.

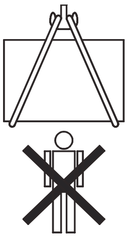
The appropriate machining process is solely selected by the operating personnel of the machine tool.

Danger!

In case of a risk of explosion in the machine room, the machine tool must not be operated.

3 Transport and commissioning

3.1 Preface



STOP **Danger!**

During the transport, no persons may be present in the danger zone.

FEHLMANN AG urgently recommends to have the machine commissioned by FEHLMANN personnel due to the various influences which may affect the machine. This should not only be done for warranty reasons, for at the same time:

- the FEHLMANN product will be controlled (for any transport damage)
- the operating staff will be instructed and trained
- additional information and advice on operation and maintenance of the product will be provided

Note!

FEHLMANN AG can not be held liable for damage caused by the improper commissioning without FEHLMANN personnel.

3.1.1 Type of packing

The transport path decides on the type of packing. The degree of disassembly depends on the transport conditions, the local conditions, the accessory and options as well as on the hoisting gear available.

In order to protect the FEHLMANN products against corrosion during the transport, all bright parts are treated with an anti-corrosion oil. Depending on the target location, the transport components are additionally wrapped in anti-corrosion paper and covered with a plastic foil.

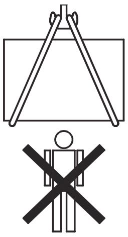
3.1.2 Opening the packing

When opening the packing, it is of particular importance not to remove the plastic foil and anti-corrosion paper but before the components delivered will have adjusted to the room temperature (after approx. 48 hours) as otherwise there is the risk of corrosion due to condensed water.

Simultaneously, the entire delivery contents must be checked for completeness and/or any transport damage.

3.2 Internal transport

3.2.1 Transport by lifting crane



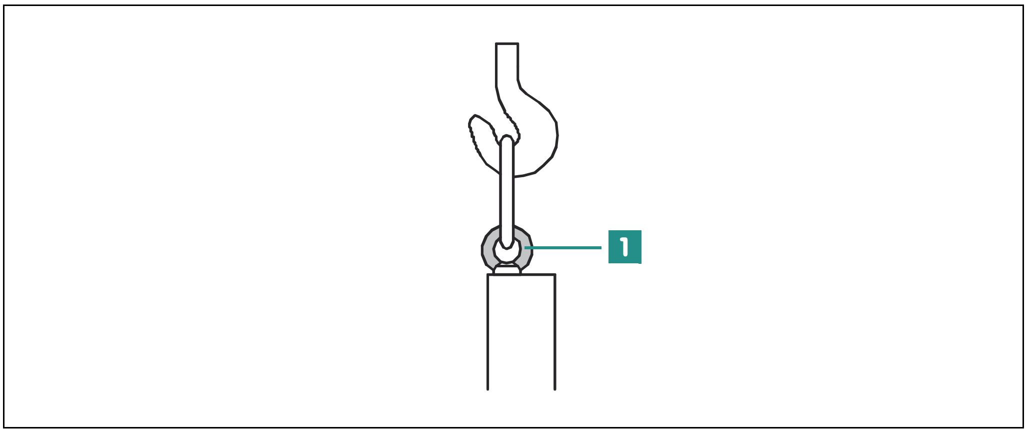
STOP

Danger!

During the transport of the machine tool, no persons may be present in the danger zone.

The machine tool is equipped with a central force application point at the column front and for the transport with the lifting crane. It is possible to lift the entire machine tool with a rope or with a hook at a lifting screw. Here, the machine head must be in a position which is as low as possible.

1 Lifting screw M24



STOP

Danger!

The carrying capacity of the crane must be higher than the weight of the machine tool.

Weight specifications of the weight machine. ***See paragraph 7.1.1 Dimensions/space requirement/weights.***

3.2.2 Transport by forklift truck

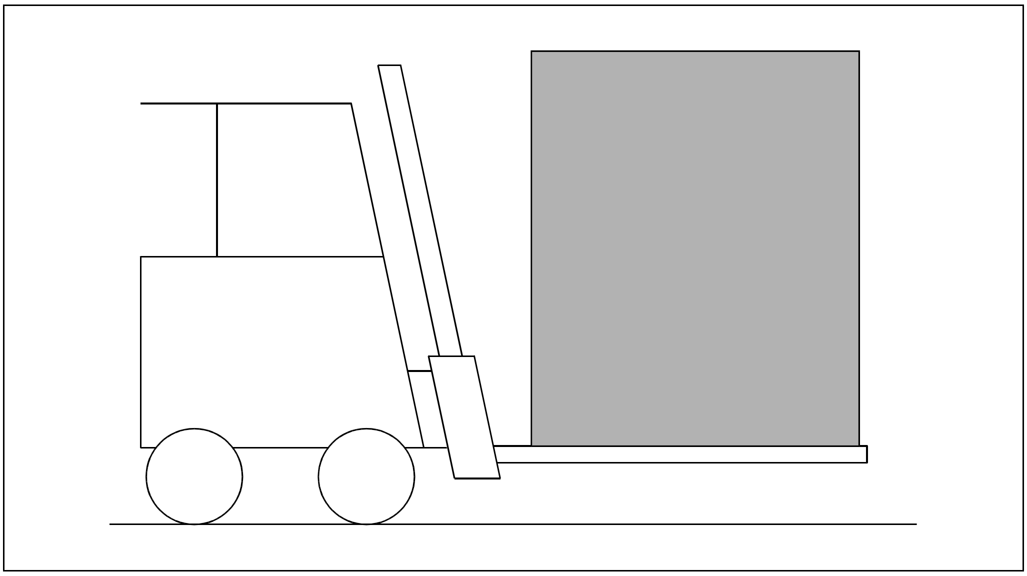
For the transport by forklift truck, the truck may drive under the machine from one side only. The prohibited side is marked.

STOP **Danger!**

The forklift truck capacity of the crane must be higher than the weight of the machine tool.

Weight specifications of the weight machine. ***See paragraph 7.1.1 Dimensions/space requirement/weights.***

Fork length min. = 1.5 m



3.3 Installation requirements

Note!

Direct heat radiation may affect the accuracy of the machine tool.

The machine must be installed at a location where it is not exposed to direct heat radiation (sun, heating).

Otherwise, the precision of the machine tool can not be guaranteed. For its due and efficient operation, the machine tool must permanently be set-up in a horizontal position on level ground.

The machine tool does not require its own foundation. However, it must be ensured, that the ground is free of vibration and offers a sufficiently high carrying capacity.

3.3.1 Temperature-time profile

Higher and higher demands are made on today's machine tools and the related options and accessories. Therefore, also the environmental conditions must be matched to the new requirements.

Note!

FEHLMANN AG recommends to draw up a temperature:time profile of the machine installation site prior to installing the machine.

In this way, it may be checked whether the required environmental conditions can be adhered to.

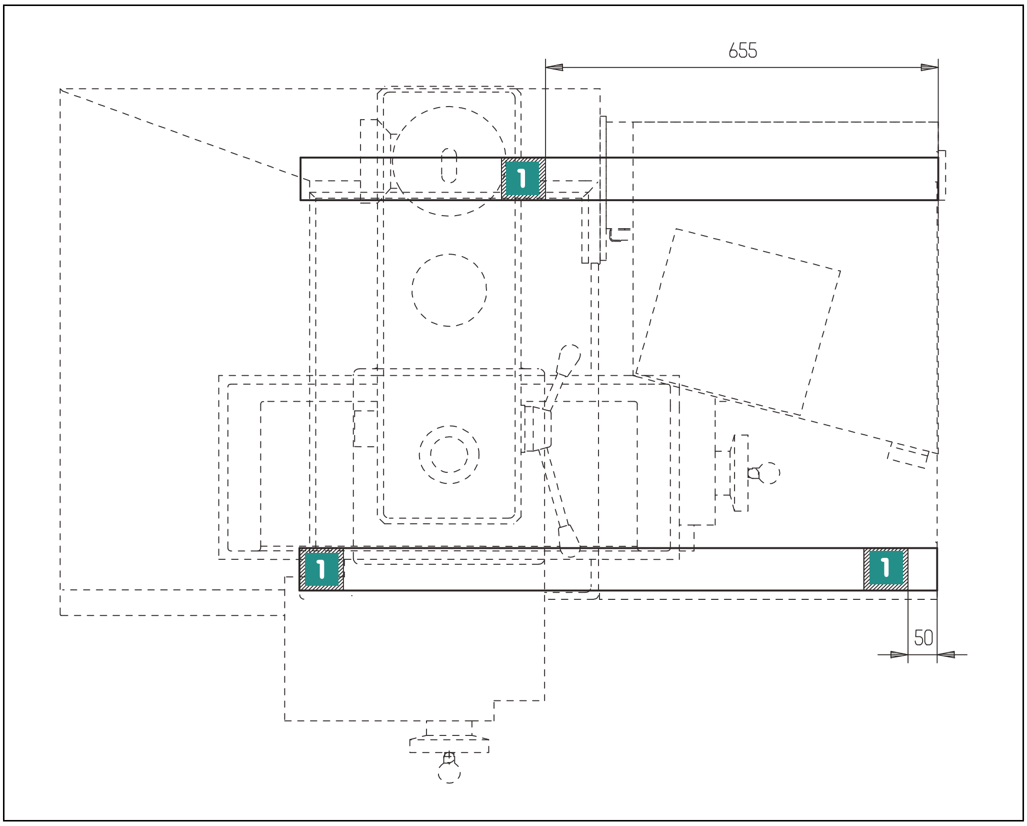
If workpieces cannot be machined true to size due to varying environmental conditions, the max. permissible environmental conditions must be improved depending on the required product accuracy.

Possible measures:

- Reduction of the direct heat radiation (sun, heat, etc.)
- Air conditioner
- Constructive measures

3.4 Commissioning works mechanical

1 Vibration insulating plates
Air Loc 100 x 100



Machine tool installation

Lift the machine tool and move it to the correct installation side.

Place the vibration insulating plates at the specified position and set down the machine tool. If necessary, level the machine tool by placing metal plates under it.

Cleaning

Before the commissioning of the machine tool, the rust-preventive oil must be removed thoroughly from the machine tool. All bright parts can easily be oiled.

Caution!

The table guideways must carefully be cleaned and re-oiled prior to the first table movement.

Lubrication

Before the commissioning of the machine tool, the machine tool must be supplied with a sufficient amount of oil. In order to achieve this, the lubrication points of the machine tool and of the coordinate table must be lubricated with the supplied oil-press.

Caution!

This lubrication must be executed after every prolonged standstill of the machine tool or of the coordinate table.

3.5 Commissioning works - electrical wiring

The electrical wiring of the machine tool may only be carried out by a qualified and specially trained electrician. He/she must thoroughly read and understand the electrical circuit diagrams. After the electrical wiring of the machine tool, the entire electrical system must be checked for its proper function. The machine tool must be correctly grounded while all electrical outputs must be covered properly. Furthermore, all selector switches must be set to the OFF or zero position [0]. Finally, all machine switches, manual limit switches and/or other switches must be adjusted to allow for a safe set-up of the machine.

If local regulations require the use of residual-current protective devices (option), FEHLMANN AG recommends the use of residual-current protective devices with a time-delay turn-on characteristic, due to the interference suppressor filter which is employed in the control cabinet. ***See paragraph 7.2.1 Residual-current protective devices (option).***

STOP **Danger!**

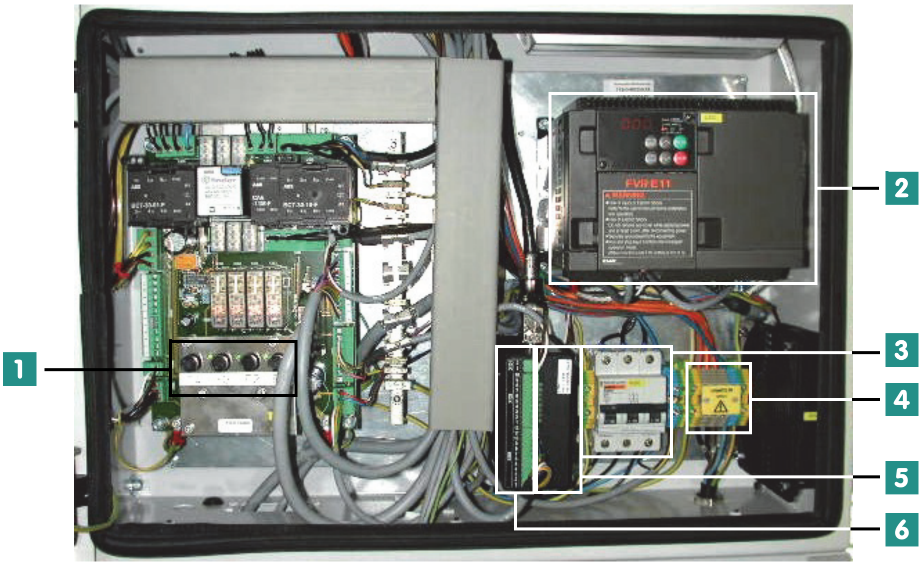
Safety limit switches may never be bypassed electrically.

The electrical wiring of the machine tool is completed by closing the doors of the control cabinet and setting the machine main switch at the control cabinet to the OFF position [0].

If the electrician is not able to complete the electrical wiring leaving the machine tool unattended the main switch must always be locked in the OFF or zero position [0].

3.5.1 Mains connection

1	Pico fuses F1–F4 + 3 green LEDs
2	Frequency converter (spindle drive)
3	Mains fuse
4	Mains connection + 3 pole conductors + 1 zero conductor + 1 ground conductor
5	Power supply Centring magnifying glass (option)
6	In and output module (option POSITIP 880)



Caution!

No additional electrical consumer may be connected to the machine tool.

Lock the machine main switch

Lock the machine main switch in the **0** position using a padlock.

Make the mains connection in accordance with the local regilations

Caution!

FEHLMANN machine tools are designed to operate at 3x400 V/50 Hz.

Any other operating voltages or frequences must be harmonised with FELMANN AG beforehand.

Effect the mains connections of the machine tool in accordance with the local regulations. For this purpose, the following terminals are provided in the control cabinet:

- 3 x pol conductors (L1, L2, L3)
- 1 x zero conductor (N)
- 1 x ground conductor (PE)

Checking the mains connection

Check that all cables are properly connected within the control cabinet.

Make sure that all safety cut-outs are switched down.

Check whether the power supply is connected with 3 pole conductors, 1 zero conductor and 1 ground conductor.

Switch on the machine tool.

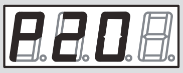
Check in the control cabinet whether the three GREEN light-emitting diodes illuminate for the Pico fuses.

If not, switch-off the machine tool and correct the mains connection. Possible troubleshooting: switch two pole conductors or connect all pole conductors.
Re-check the mains connection.

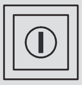
3.6 Function check

Starting the machine tool

Switch on the machine tool.



After switching on the main switch, P20 is displayed on the digital display of the machine control panel.



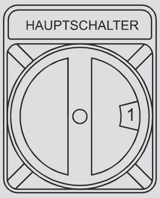
Switch on the control voltage.

Note!

The control voltage cannot be switched on with the EMERGENCY STOP button pressed.

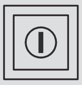
The EMERGENCY STOP button must be unlocked (reset).

Starting the machine tool (option ND 780)



Switch on the machine tool.

After switching on the main switch, P20 is displayed on the digital display of the machine control panel.



Switch on the control voltage.

Note!

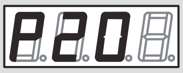
The control voltage cannot be switched on with the EMERGENCY STOP button pressed.

The EMERGENCY STOP button must be unlocked (reset).

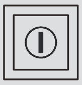
Delete the message by pressing any key.

Starting the machine tool (option POSITIP 880)

Switch on the machine tool.



After switching on the main switch, P20 is displayed on the digital display of the machine control panel.



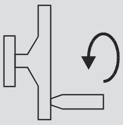
Switch on the control voltage.

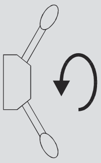
Note!

The control voltage cannot be switched on with the EMERGENCY STOP button pressed.

The EMERGENCY STOP button must be unlocked (reset).

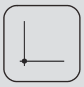
Delete the message by pressing a key.



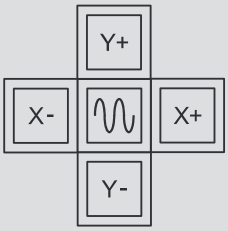


Approach the machine reference point of each axis.

- The X and Y axes are moved manually via the mechanical hand wheels.
- The Z axis of quill axis is moved manually by 50 mm via the drill lever.



ACTUAL VALUE

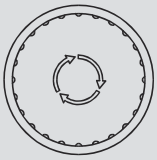


Using the axis direction keys, the axes are moved at normal feedrate and in rapid feed mode.

Move the axes to their final positions until the corresponding axis direction key illuminates.

Checking the EMERGENCY STOP button

Load a tool holder and start the work spindle at a speed of approx. 1,000 rpm.



Press the EMERGENCY STOP button.

Danger!

Pressing the EMERGENCY STOP button must immediately switch off spindle drive, all axes, and the auxiliary units.

In case of a malfunction of the EMERGENCY STOP button, inform the FEHLMANN customer service without delay.

Checking the work spindle for smooth running

Mode a tool holder and warm-up the work spindle at approx. 1,000 rpm.

Continuously increase the spindle speed up to the max. limit and check the work spindle for smooth running.

3.6.1 Maintenance

3.6.1.1 Safety devices

Checking the EMERGENCY STOP button	
Interval	once per month

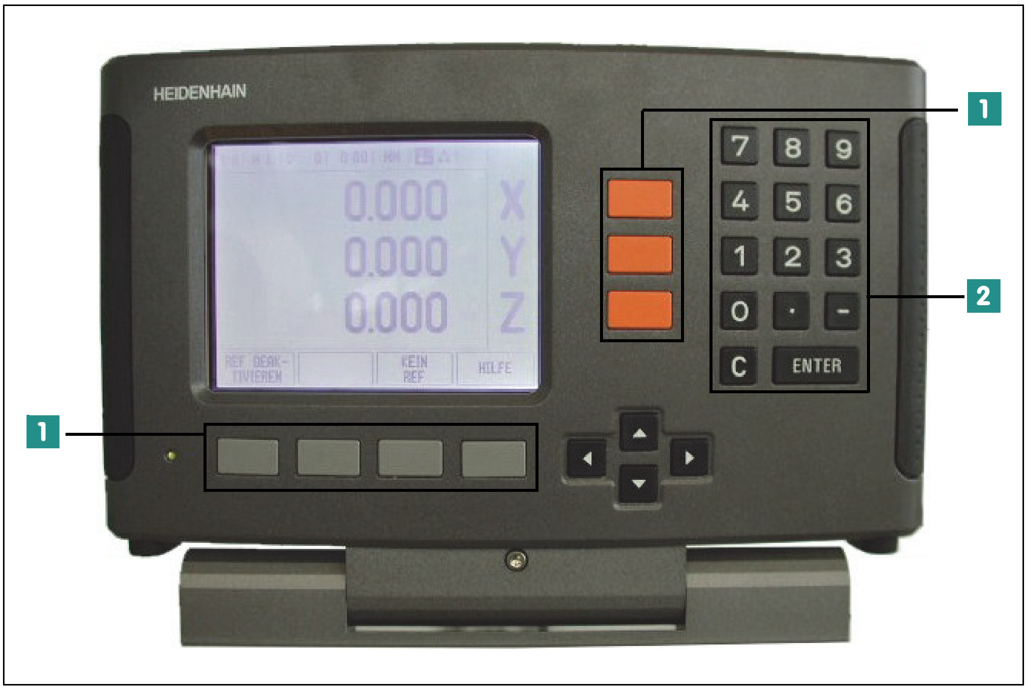
Checking the work spindle for smooth running	
Interval	once per month

4 Operation and maintenance

4.1 Operating elements ND 780 (option ND 780)

1 Operating elements at the monitor unit

2 Value input and editing



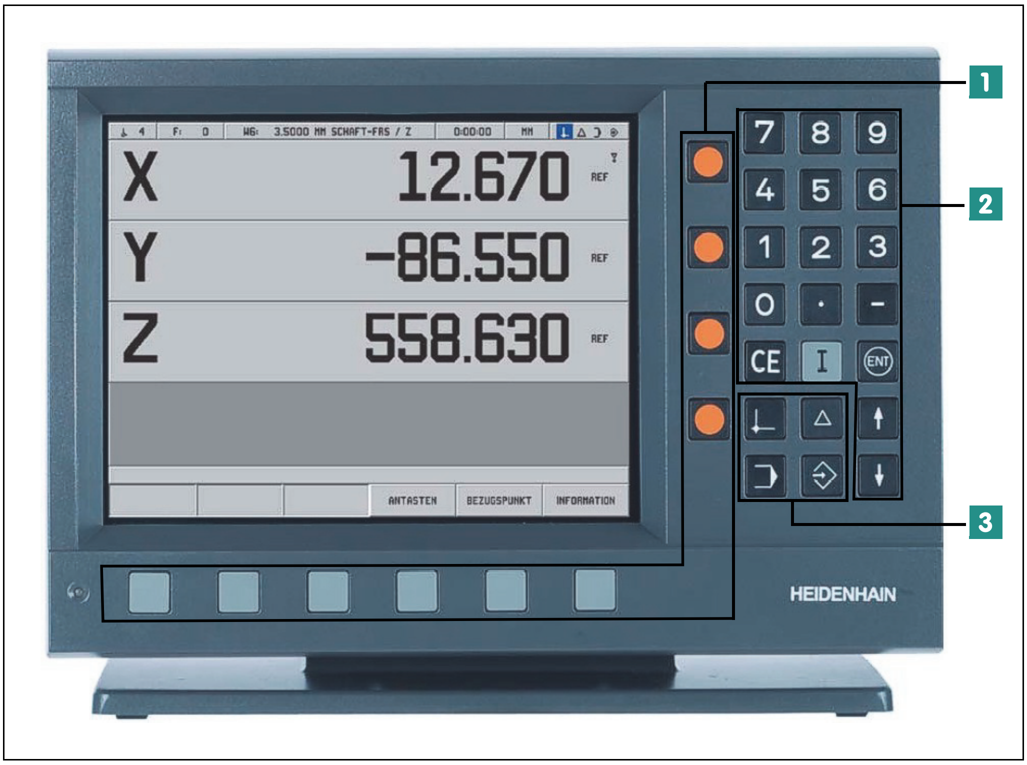
For detailed information, see HEIDENHAIN operating manual.

4.2 Operating elements and POSITIP modes POSITIP 880 (option POSITIP 880)

1 Operating elements at the monitor unit

2 Value input and editing

3 POSITIP modes keys



4.2.1 Operating elements of the monitor unit

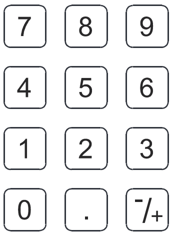
Softkey keys

The functions assigned to the various softkeys are displayed in the softkey line.

Axis keys

Used to select the displayed feed axes.

4.2.2 Operating elements of the keyboard unit



Numerical keypad

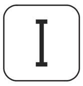
Numbers are input via the numerical keypad with decimal point and sign keys. Leading zeros before the decimal point may be omitted.

Signs may be input during and after the numerical entry.

Wrong entries may be deleted and entered correctly by pressing the **CE** key before confirming the input.

CE

Clear entry or error messages.

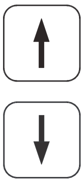


Incremental dimension

Input of the position in the incremental dimension (incremental).

ENTER

Confirm entry



Vertical arrow keys

Select entry fields

4.2.3 POSITIP modes

4.2.3.1 POSITIP mode MACHINE

ACTUAL VALUE
Position display for workpiece machining. Zero reset. Datum setting (also with edge finder).

DISTANCE-TO-GO
Distance-to-go display. Hole patterns. Milling and Drilling with tool radius compensation.

4.2.3.2 POSITIP mode PROGRAMMING

PROGRAMMING
Storage of work steps for small-lot production.

SINGLE BLOCK

EXECUTE PROGRAM
Execute programs which have previously been created in the POSITIP mode **PROGRAMMING**. The program is processed block by block.

AUTOMATIC

EXECUTE PROGRAM
Execute programs which have previously been created in the POSITIP mode **PROGRAMMING**. The program is worked off continuously.

4.2.3.3 Working with the POSITIP mode MACHINE

For detailed information, see HEIDENHAIN operating manual.

4.2.3.4 Working with the POSITIP mode PROGRAMMING

For detailed information, see HEIDENHAIN operating manual.

4.2.4 POSITIP Menu JOB SETUP

JOB SETUP

The POSITIP menu **JOB SETUP** allows for important changes to machine tool and control unit.

4.2.4.1 Starting the POSITIP Menu JOB SETUP

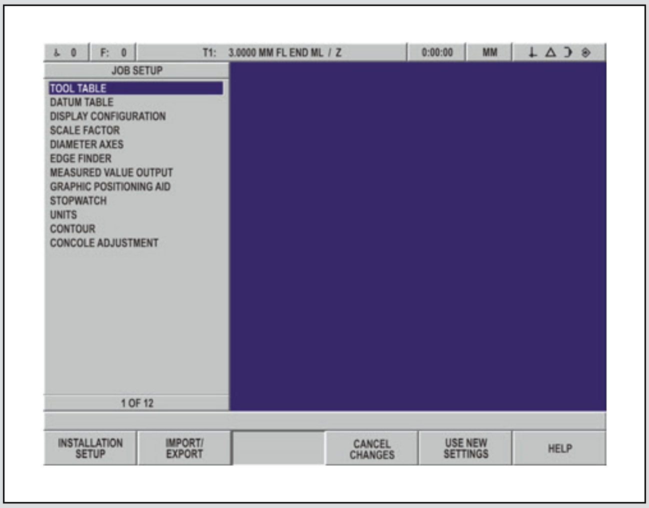
In order to utilize the POSITIP Menu **JOB SETUP** the following steps are required:

INFO

Select Softkey INFO

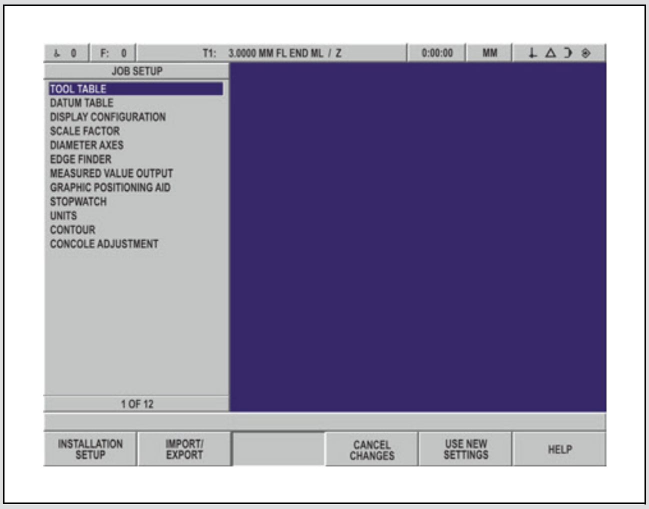
JOB SETUP

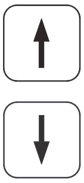
Select Softkey JOB SETUP



The cursor jumps automatically to the first menu item TOOL TABLE.

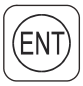
4.2.4.2 Working with the POSITIP Menu JOB SETUP





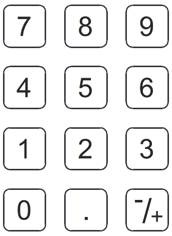
Selecting the desired menu item

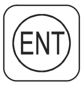
Use the vertical arrow keys to move the cursor from one field to the other.



Moving to the selected menu item

Use the ENT key to move the cursor to the selected menu item.





Entering numbers in fields

In some fields, numerical values will be input which are then taken over by the ENT key.

Exiting the POSITIP submenu

Select the softkey USE. All the necessary data that has been input in the input screen will be accepted

or

Select the softkey CANCEL. All the necessary data that has been input in the input screen will be rejected.

CANCEL CHANGES

Quit POSITIP Menu JOB SETUP

Select Softkey CANCEL CHANGES. (The changes that were made will not be saved.)

USE NEW SETTINGS

Quit POSITIP Menu JOB SETUP

Select Softkey USE NEW SETTINGS. (The changes that were made will be saved.)

TOOL TABLE

Tool Table

The tool table will support up to 99 tools containing information on the diameter, length and type.

DATUM TABLE

Datum Table

The datum table shows the absolute locations of the datums relative to the reference mark (max. 99 datums).

DISPLAY CONFIGURATION

Display Configuration

The DISPLAY CONFIGURATION form is where the operator determines which axes are displayed and in what order.

SCALE FACTOR

Scale Factor

The scale factor may be used to scale the part up or down from the programmed size.

DIAMETER AXES

Diameter Axes

This input screen allows the operator to determine if the axis values are to be displayed as radius or as diameter. (Only for the POSITIP application **TURNING**.)

EDGE FINDER

Edge Finder

The diameter and length offset of the edge finder are set in this form.

MEASURED VALUE OUTPUT

Measured Value Output

With the measured value output feature, the current axis display positions and probe measurement values can be sent over the serial and/or parallel ports.

GRAPHIC POSITIONING AID

Graphic Positioning Aid

This form is used to configure the bar graph that is shown below the axes DRO display in the POSITIP mode DISTANCE-TO-GO.

STOPWATCH

Stopwatch

The stopwatch shows the hours (h), minutes (m), seconds (s).

UNITS

Units

This form is used to specify the preferred display units and format.

CONTOUR

Contour

This form is used to enable or disable the feature and to set the tolerance bands.

CONSOLE ADJUSTMENT

Console Adjustment

This form ist used to adjust the brightness for the main console, the brightness for the remote console and the display saver.

For detailed information, see HEIDENHAIN operating manual.

4.2.5 POSITIP Menu INSTALLATION SETUP

INSTALLATION SETUP

With the help of the following **passcode**, the installation setup is available:

95148	POSITIP Menu INSTALLATION SETUP

95148

4.2.5.1 Starting the POSITIP Menu INSTALLATION SETUP with passcode

INFO

Select Softkey INFO

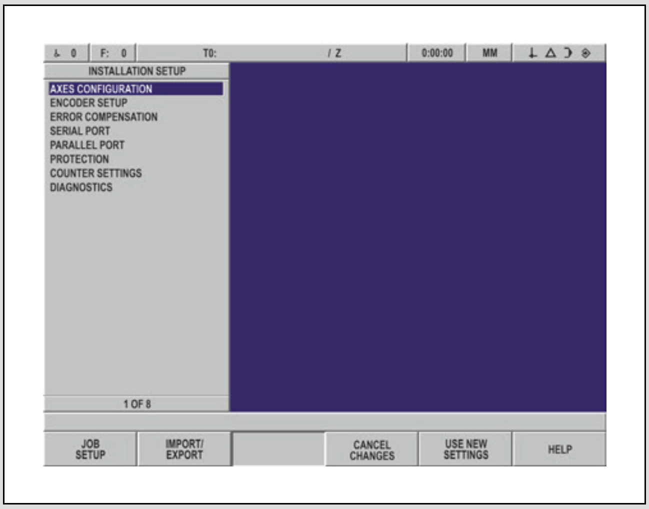
INSTALLATION SETUP

Select Softkey INSTALLATION SETUP

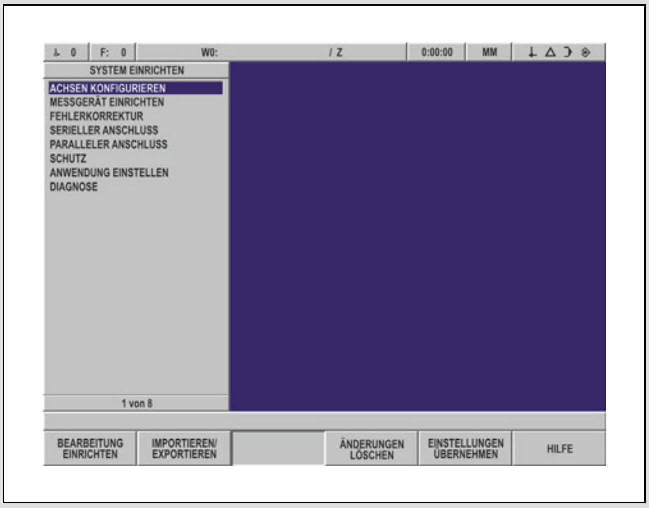
95148

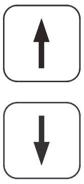
ENT

Enter passcode



4.2.5.2 Working with the POSITIP Menu INSTALLATION SETUP



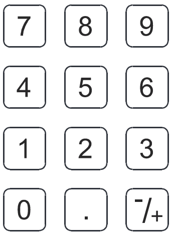


Selecting the desired menu item

Use the vertical arrow keys to move the cursor from one field to the other.

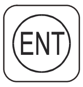
Moving to the selected menu item

Use the ENT key to move the cursor to the selected menu item.



Entering numbers in fields

In some fields, numerical values will be input which are then taken over by the ENT key.



Exiting the POSITIP submenu

Select the softkey USE. All the necessary data that has been input in the input screen will be accepted

or

Select the softkey CANCEL. All the necessary data that has been input in the input screen will be rejected.

CANCEL CHANGES

Quit POSITIP Menu INSTALLATION SETUP

Select Softkey CANCEL CHANGES. (The changes that were made will not be saved.)

USE NEW SETTINGS

Quit POSITIP Menu INSTALLATION SETUP

Select Softkey USE NEW SETTINGS. (The changes that were made will be saved.)

AXES CONFIGURATION

Axes Configuration

The configuration parameter allows encoder inputs (X1-X6) to be assigned to displayable axes. The axis may consist of a single encoder input or may be a combination of two encoders (2nd encoder position added or subtracted from the 1st).

ENCODER SETUP

Encoder Setup

This form is used to set the encoder resolution and type (linear, angular), count direction, reference mark type.

ERROR COMPENSATION

Error Compensation

An Error can occur due to ball screw pitch error or deflection and tilting of axis. From an analysis of the error it can be determined which form of compensation is required, linear or non-linear error.

Note!

Error compensation ist only available when using linear encoders.

SERIAL PORT

Serial Port (X31)

A printer or computer may be connected to the serial port. Part programs and configuration files may be sent to a printer or computer. Remote commands, remote key codes, part programs and configuration files may be received from a computer.

PARALLEL PORT

Parallel Port (X32)

A printer may be connected to the parallel port.

PROTECTION

Protection

The protection feature lets you prevent changes to part programs, the tool table and datum 0.

COUNTER SETTINGS

Counter Settings

This feature is the parameter where the operator defines the POSITIP user application for the readout. The choices ar for **MILLING** or **TURNING** POSITIP applications. The standard setting corresponds to the POSITIP application **MILLING**.

DIAGNOSTICS

Diagnostics

These parameters can be used to check the following:

- Keypad test
- Display test
- Voltage monitor
- Encoder signal plot
- System statistics

SWITCHING OUTPUTS

Input and output modules (option)

If the input and output module is connected to the position display POSITIP 880, the menu item SWITCHING OUTPUTS will be additionally displayed. Eight digital switching outputs can be configured for the input and output module.

Caution!

Modifications on the switch configuration may cause malfunction of the motor table control (option).

For detailed information, see HEIDENHAIN operating manual.

4.2.6 POSITIP menu LANGUAGE selection

INFO

Select Softkey INFO

LANGUAGE

Select Softkey INFO

Keep pressing the softkey until the desired language is displayed:

- German
- Dutch
- English
- French
- Hungarian
- Italian
- Polish
- Spanish
- Finnish
- Schwedish
- Czech
- Danish

USE

Press the softkey USE and confirm the selected language with YES

Caution!

Each time the language is changed, POSITIP 880 is restarted. This process corresponds to switching the POSITIP 880 on and off. *See paragraph 4.5.3 Machine tool start (option POSITIP 880).*

4.3 Data back-up (option POSITIP 880)

4.3.1 General

The backup of configurations and NC programs is a crucial factor for the safe operation of a machine tool. Any data loss - e.g. through an error in the control unit - means unnecessary machine downtimes as well as the loss of the NC programs stored in the control unit.

Configurations (Machine data)

FEHLMANN AG recommends to backup the configurations on an external data carrier each time machine data are changed. This data carrier must be stored at an appropriate place where it is protected from destruction but can be accessed at any time. It is only in this way that the control status as before the data loss can be restored within the shortest time possible.
If the company disposes of a data backup system the machine data must be integrated into this system.

Note!

FEHLMANN AG recommends to backup the configurations on an external data carrier after each modification.

NC programs

FEHLMANN AG recommends to backup NC programs in regular intervals.

Note!

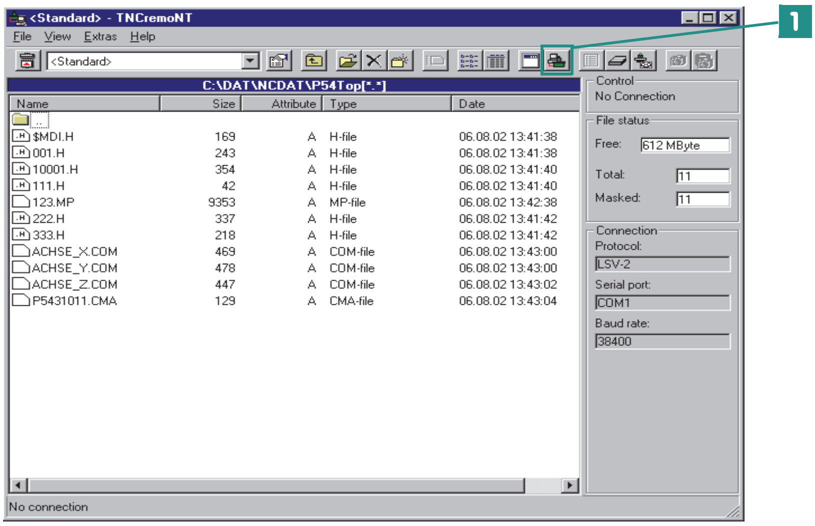
FEHLMANN AG recommends to backup the NC programs on an external data carrier in regular intervals.

4.3.2 Software TNCremoNT/TNCserver

The FEHLMANN AG recommends the software TNCremoNT by Messrs. Heidenhain in Traunreut for backing up the data on the POSITIP 880. The software may be downloaded via the Internet **www.heidenhain.de** as shareware.

TNCremoNT

1 Subprogram TNC server



<Standard> - TNCremoNT

<Standard>

C:\DAT\NCDAT\P54Top[*.*]

Name	Size	Attribute	Type	Date
..				
$MDI.H	169	A	H-file	06.08.02 13:41:38
001.H	243	A	H-file	06.08.02 13:41:38
10001.H	354	A	H-file	06.08.02 13:41:40
111.H	42	A	H-file	06.08.02 13:41:40
123.MP	9353	A	MP-file	06.08.02 13:42:38
222.H	337	A	H-file	06.08.02 13:41:42
333.H	218	A	H-file	06.08.02 13:41:42
ACHSE_X.COM	469	A	COM-file	06.08.02 13:43:00
ACHSE_Y.COM	478	A	COM-file	06.08.02 13:43:00
ACHSE_Z.COM	447	A	COM-file	06.08.02 13:43:02
P5431011.CMA	129	A	CMA-file	06.08.02 13:43:04

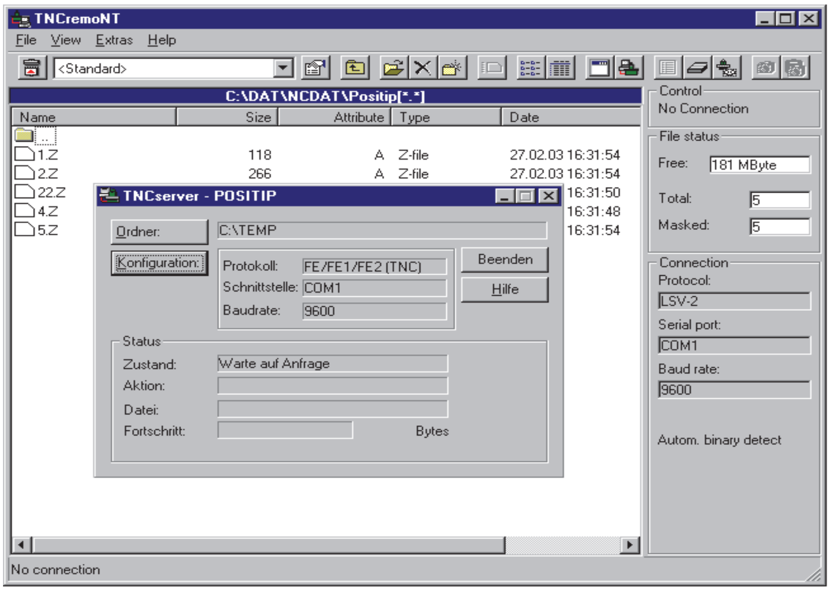
Control
No Connection

File status
Free: 612 MByte
Total: 11
Masked: 11

Connection
Protocol: LSV-2
Serial port: COM1
Baud rate: 38400

No connection

Total view TNCremoNT and TNCserver



TNCremoNT

<Standard>

C:\DAT\NCDAT\Positip[*.*]

Name	Size	Attribute	Type	Date
..				
1.Z	118	A	Z-file	27.02.03 16:31:54
2.Z	266	A	Z-file	27.02.03 16:31:54
22.Z				16:31:50
4.Z				16:31:48
5.Z				16:31:54

TNCserver - POSITIP

Ordner: C:\TEMP

Konfiguration:
Protokoll: FE/FE1/FE2 (TNC)
Schnittstelle: COM1
Baudrate: 9600

Status
Zustand: Warte auf Anfrage
Aktion:
Datei:
Fortschritt: Bytes

Control
No Connection

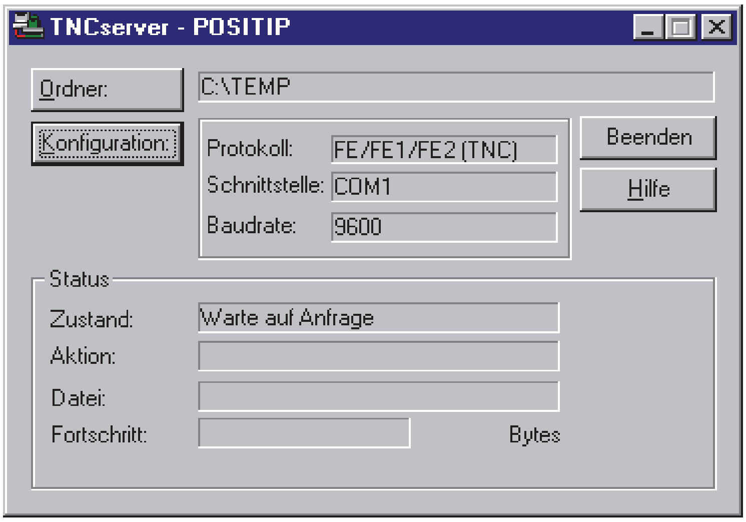
File status
Free: 181 MByte
Total: 5
Masked: 5

Connection
Protocol: LSV-2
Serial port: COM1
Baud rate: 9600

Autom. binary detect

No connection

TNCserver



TNCserver - POSITIP

Ordner: C:\TEMP

Konfiguration:

Protokoll: FE/FE1/FE2 (TNC)

Schnittstelle: COM1

Baudrate: 9600

Status

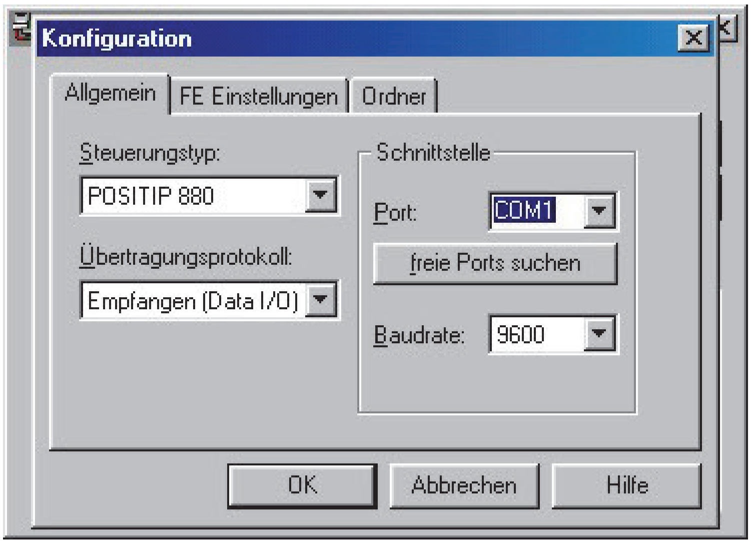
Zustand: Warte auf Anfrage

Aktion:

Datei:

Fortschritt: Bytes

TNCserver – configuration – generally



Konfiguration

Steuerungstyp: POSITIP 880

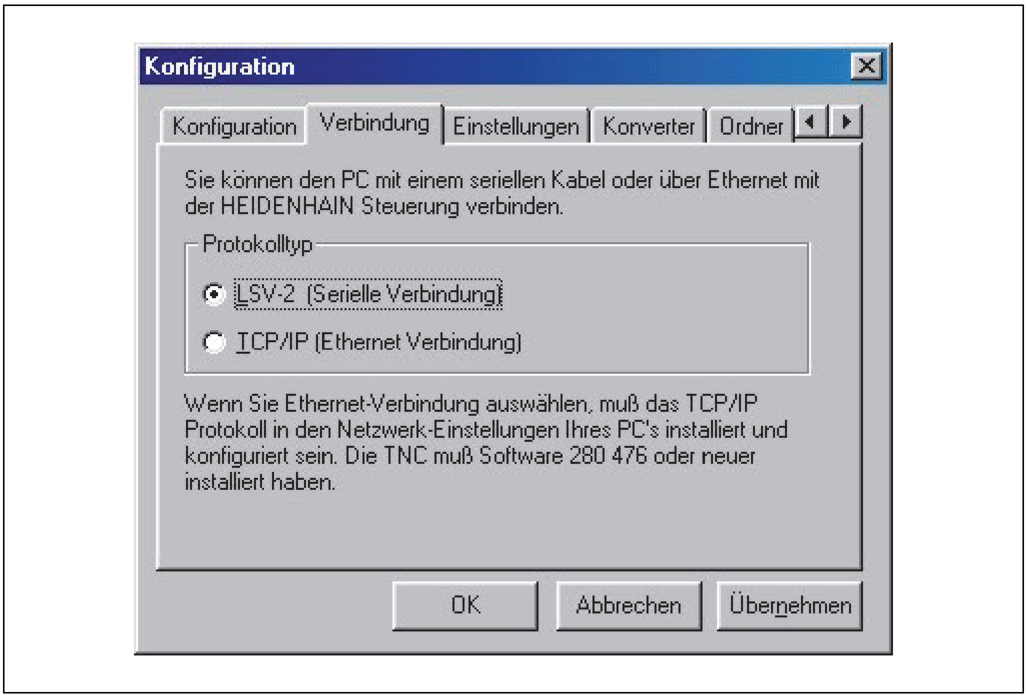
Übertragungsprotokoll: Empfangen (Data I/O)

Schnittstelle

Port: COM1

Baudrate: 9600

TNCserver – configuration – connection



Sie können den PC mit einem seriellen Kabel oder über Ethernet mit der HEIDENHAIN Steuerung verbinden.

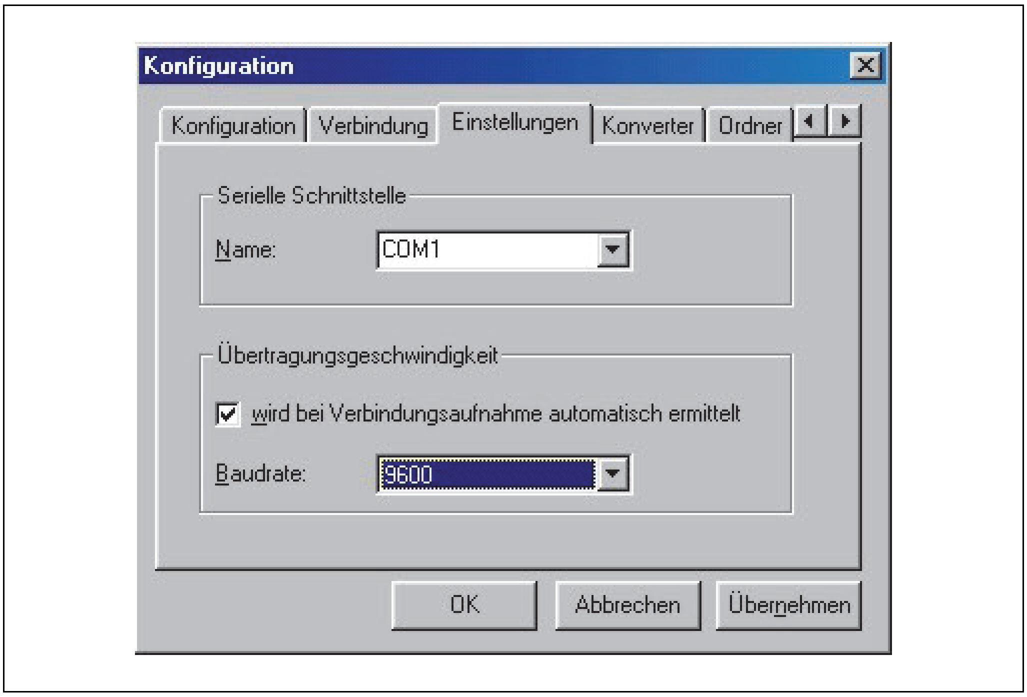
Protokolltyp

● LSV-2 (Serielle Verbindung)

○ TCP/IP (Ethernet Verbindung)

Wenn Sie Ethernet-Verbindung auswählen, muß das TCP/IP Protokoll in den Netzwerk-Einstellungen Ihres PC's installiert und konfiguriert sein. Die TNC muß Software 280 476 oder neuer installiert haben.

TNCserver – configuration – settings



Serielle Schnittstelle

Name: COM1

Übertragungsgeschwindigkeit

☑ wird bei Verbindungsaufnahme automatisch ermittelt

Baudrate: 9600

TNCremoNT	
Software	TNCremoNT
FEHLMANN order number	5504-001

Note!

FEHLMANN AG would like to draw your attention to the fact that any questions and problems concerning the TNCremoNT software shall be directed to Messrs. HEIDENHAIN.

Technical information and data support may be found under www.heidenhain.de.

4.3.2.1 Backing up and restoring machine data

Before starting to actually backup data on an external data carrier the data interface must be set to the individual peripheral device using TNCremoNT and the cables for the reading/writing of data must be wired. ***See paragraph 4.3.3 Pin assignment and connecting cable for data interfaces.***

Set interface

INFO

Select Softkey INFO

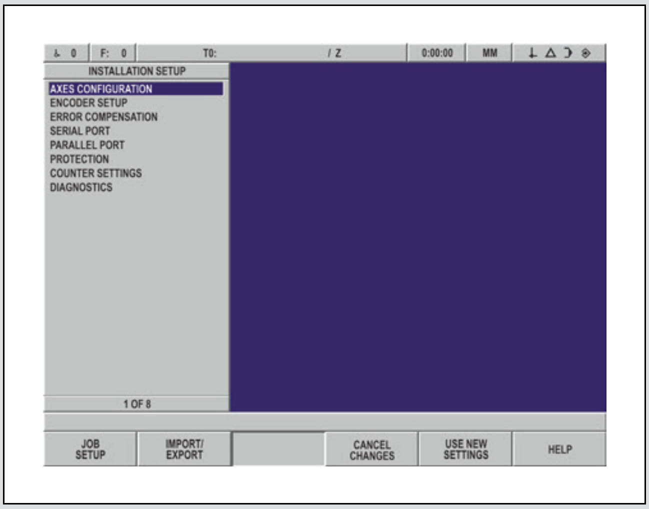
INSTALLATION SETUP

Select Softkey INSTALLATION SETUP

95148

ENT

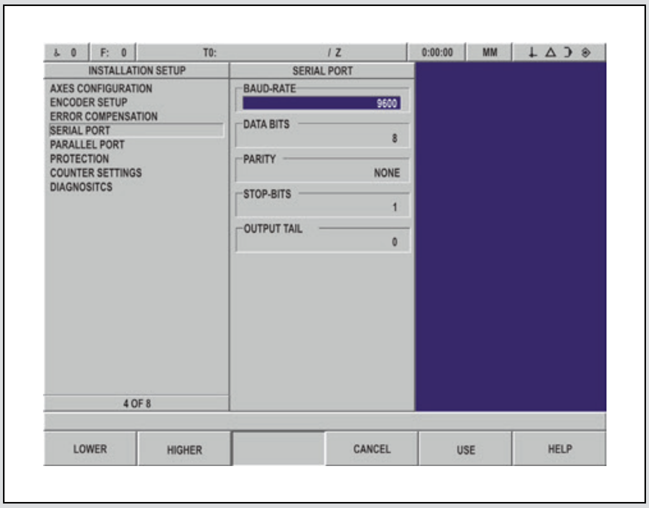
Enter PASS CODE



↑ ↓

ENT

Select Menu item SERIAL PORT



BAUD-RATE 9600

DATA BITS 8

PARITY NONE

STOP-BITS 1

OUTPUT TAIL 0

- Baud rate = 9600 (recommended)

The baud rate setting in the TNC server window must be identical.

↑ ↓

Use the vertical arrow keys to move from one parameter field to the other.

LOWER

HIGHER

Use the softkeys LOWER and HIGHER to change the values inside the selected parameter field.

USE

USE

Quit the POSITIP submenu SERIAL PORT. The modified settings will be accepted.

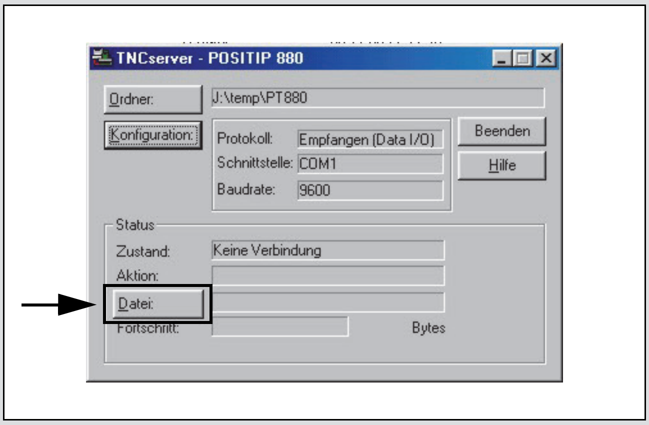
USE NEW SETTINGS

USE NEW SETTINGS

Quit POSITIP Menu INSTALLATION SETUP

Saving configurations on an external storage medium

Start TNCremoNT subprogram **TNCserver**



TNCserver - POSITIP 880

Ordner: J:\temp\PT880

Protokoll: Empfangen (Data I/O)
Schnittstelle: COM1
Baudrate: 9600

Status
Zustand: Keine Verbindung
Aktion:
Datei:
Fortschritt:

At file, enter a file name under which the operation configuration data are to be saved.

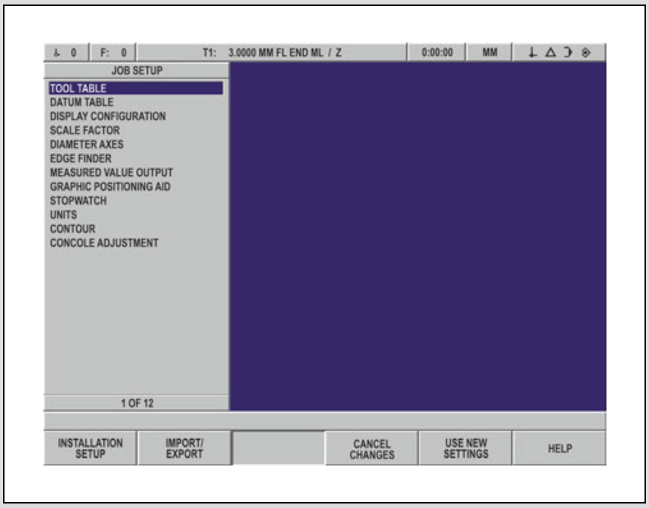
INFO

Select Softkey INFO

JOB SETUP

ENT

Select Softkey JOB SETUP



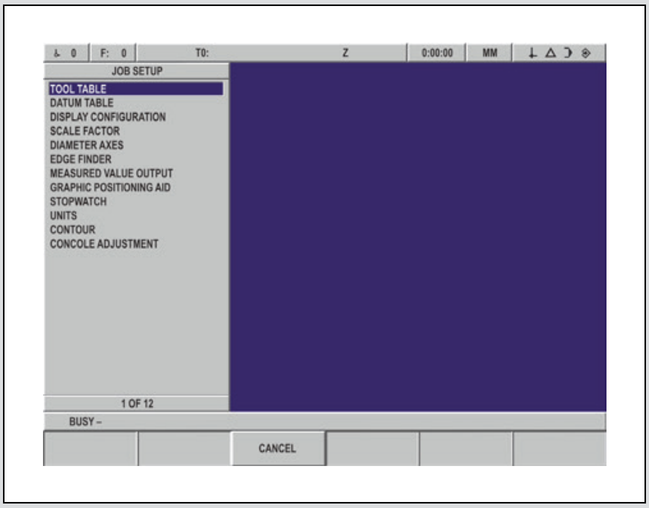
IMPORT/ EXPORT

Select Softkey IMPORT/EXPORT

EXPORT

Select Softkey EXPORT

The data transmission to the PC is started. (The active data transmission is displayed on the PC in the status window of the TNC server under status.)



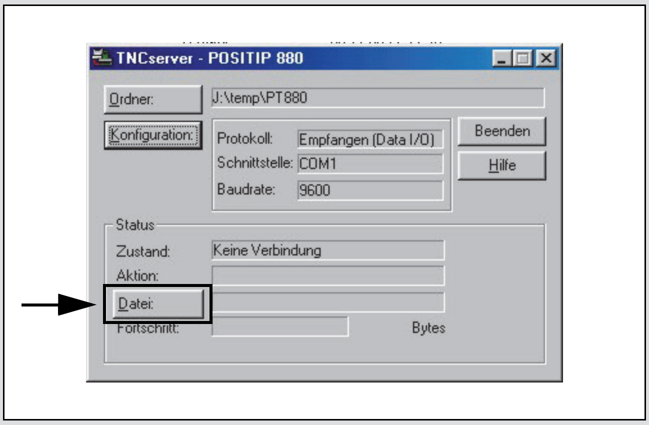
Caution!

The files on the data carrier are overwritten without a safety interrogation.

For detailed information, see HEIDENHAIN operating manual.

Saving a NC program on an external storage medium

Start TNCremoNT subprogram TNCserver



TNCserver - POSITIP 880

Ordner: J:\temp\PT880

Konfiguration:

Protokoll: Empfangen (Data I/O)

Schnittstelle: COM1

Baudrate: 9600

Status

Zustand: Keine Verbindung

Aktion:

Datei:

Fortschritt: Bytes

At file, enter a file name under which the active NC program is to be saved.

PROGRAMING

FILE OPERATIONS...

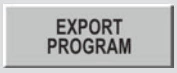
Select Softkey FILE OPERATIONS...

MORE...

Select Softkey MORE...

MORE...

Select Softkey MORE...



Select Softkey EXPORT PROGRAM

The data always receive the file name of the program and the file extension **.txt**.

Caution!

The files on the data carrier are overwritten without a safety interrogation.

For detailed information, see HEIDENHAIN operating manual.

Reading configurations from an external storage medium

For detailed information, see HEIDENHAIN operating manual.

Reading a NC program from external storage medium

For detailed information, see HEIDENHAIN operating manual.

4.3.3 Pin assignment and connecting cable for data interfaces

For detailed information, see HEIDENHAIN operating manual.

A complete connecting cable set for the data back-up can be ordered from the FEHLMANN AG.

Connecting cable RS232 - 3 m	
Manufacturer	FEHLMANN AG
Type	Data cable D-Sub 9F/9F
Length	3 m
FEHLMANN order number	116-S-700468

Connecting cable RS232 - 8 m	
Manufacturer	FEHLMANN AG
Type	Data cable D-Sub 9F/9F
Length	8 m
FEHLMANN order number	116-S-700467

4.3.4 Maintenance

4.3.4.1 Data back-up

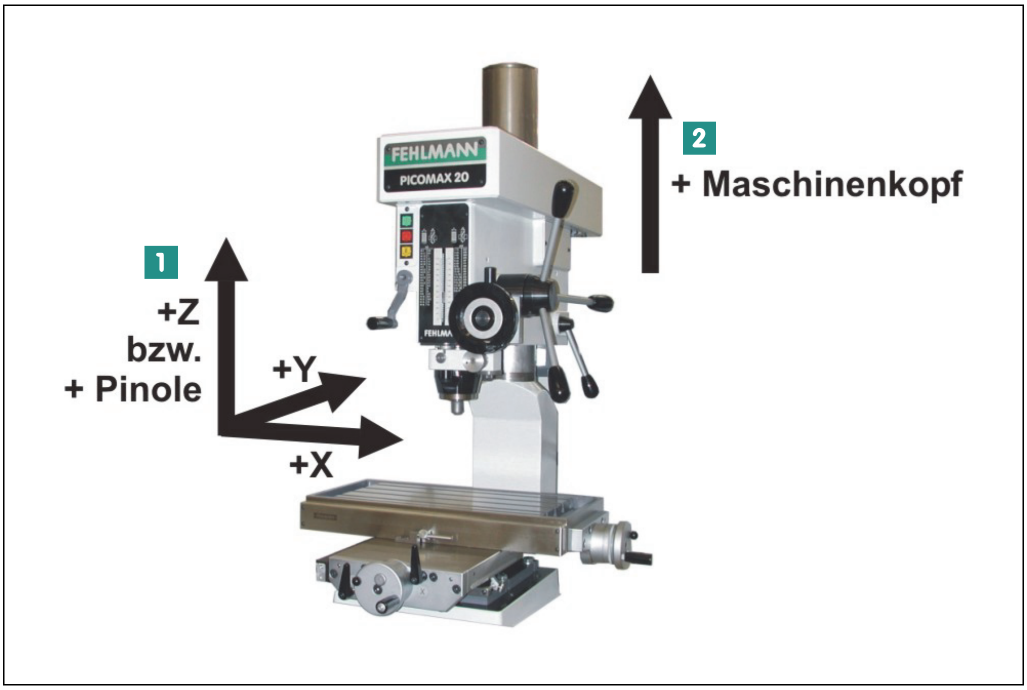
Save configurations	
Interval	after each change

Save NC programs	
Interval	once per week

4.4 Operating elements and machine operating modes FEHLMANN

4.4.1 Machine tool coordinates

1 +Z or + quill
2 + machine head

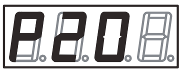


4.4.2 Switching ON/OFF

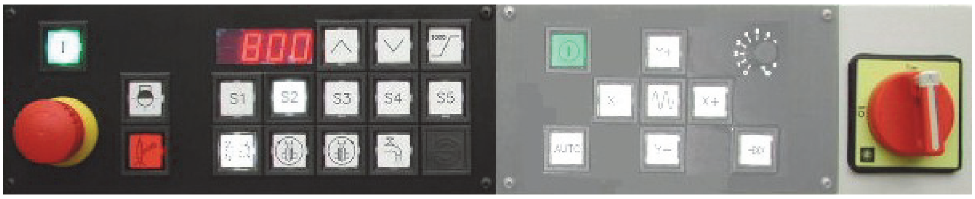
Main switch

The main switch is on the right-hand side of the control cabinet console and can be locked with padlocks for maintenance and repair works due to safety reasons. With the main switch OFF, the entire machine tool is disconnected from the power supply.

After switching on the main switch, the following message is displayed on the digital display of the machine control panel and thus displays the readiness of the machine tool:

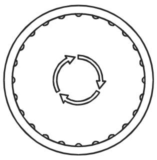


4.4.3 Machine operating panel



Key	Function
I	Control voltage ON
☀	Machine lamp ON/OFF
	Centering magnifying glass
∧	Speed INCREASE
∨	Speed DECREASE
1000	Speed limit
S1	Pre-selection key S1
S2	Pre-selection key S2
S3	Pre-selection key S3
S4	Pre-selection key S4
S5	Pre-selection key S5
	Pre-selection Drilling/milling
	Pre-selection Thread cutting, clockwise rotation

Key	**Function**
	Pre-selection Thread cutting, anti-clockwise rotation
	Coolant supply ON/OFF

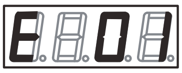


EMG STOP button

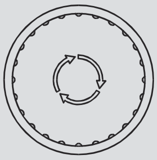
In cases of danger, the machine tool and the control unit may be switched off by pressing the EMG STOP button. This has the following effect:

- The work spindle and all rotating axes are stopped immediately and then separated from the mains galvanically. If the work spindle is stopped due to a defect, the spindle drive will switch off after approx. 3 seconds.
- Auxiliary sets, as coolant pump, are immediately switched off when pressing the EMG STOP button.

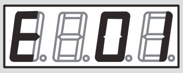
The digital display of the machine control panel displays this with the following error message:



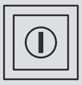
For re-starting the machine, proceed as follows:



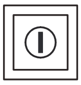
Reset the EMG STOP button by turning it in arrow direction



After releasing the EMERGENCY STOP button, the digital display of the machine control panel also displays an error message.



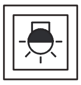
Switch on the control voltage



Control voltage ON

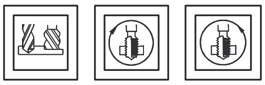
When actuating this key, the machine operating mode **DRILLING/MILLING** and the current speed of the pre-selection key S1 are automatically selected.

> **Note!**
>
> **The control voltage cannot be switched on with the EMERGENCY STOP button pressed.**
>
> **The EMERGENCY STOP button must be unlocked (reset).**



Machine lamp ON/OFF

Machine light switch on and off.

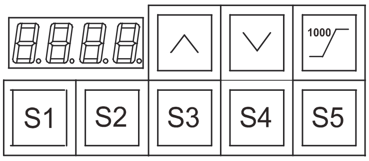


Quill axis modes

Via these keys, the different quill axis modes can be selected. ***See paragraph 4.6.2 Quill axis modes.***

4.4.3.1 Speed generator

It is possible to steplessly adjust the work spindle speed with the speed generator, this speed can then be saved via 5 different pre-selection keys.



Switch-on state of the machine tool

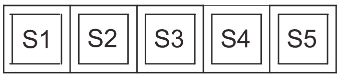
When switching on the machine tool, the following states are selected automatically:

States	
Speed	400 rpm
Machine operating mode	**DRILLING/MILLING**

Switch-on state of the pre-selection keys

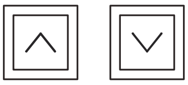
For the pre-selection keys S1 to S5, the following speeds have been programmed:

Key	**Speed**
S1	400 rpm
S2	800 rpm
S3	1500 rpm
S4	3000 rpm
S5	5000 rpm



Speed selection with pre-selection keys

It is possible to select the 5 pre-programmed speeds S1-S5 by actuating the pre-selection keys.

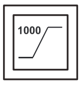


Increase or reduce saved speed

It is possible to select the saved speeds directly by actuating the pre-selection keys S1-S5. When actuating the keys speed INCREASE and speed DECREASE, the currently displayed speed value is increased or reduced by one increment. If the keys are pressed for a prolonged period of time, the speed is constantly increased or decreased.

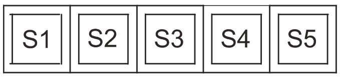
The increase or decrease increments in detail:

Speed range	Increment
50–500 rpm^{-1}	10 rpm
500-1000 rpm	20 rpm
1000-2000 rpm	50 rpm
2000-5000 rpm	100 rpm
5000-6300 rpm	200 rpm



Speed limit

By actuating the speed limit key, the speed selection is limited to a maximum value of 1000 rpm. In the machine operating mode **THREAD CUTTING, CLOCKWISE ROTATION** and in the machine operating mode **THREAD CUTTING, ANTI-CLOCKWISE ROTATION**, this limitation is activated automatically. The key illuminates.



Programming of the speed

The pre-selection keys S1-S5 are programmed in followed steps.

Example: Change pre-selection key S1 from 400 rpm to 500 rpm

Select pre-selection key S1 with the speed value 400 rpm.

The speed is increased to 500 rpm by the speed INCREASE key.

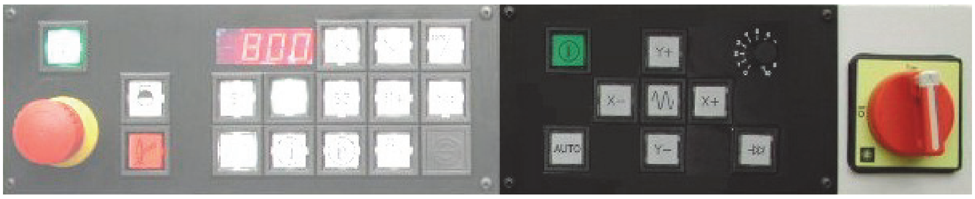
Press the pre-selection key S1 and keep it pressed until the display illuminates twice.

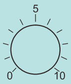
The new value of the pre-selection key S1 amounts to 500 rpm now.

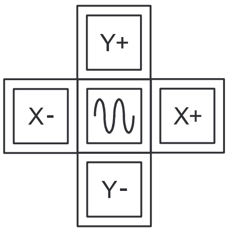
Note!

When switching off the machine tool, all speed changes are lost. When switching on the machine tool again, the pre-selection keys will be assigned again with the switching-on state.

4.4.4 Control panel motor table (option POSITIP 880)



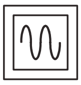
Key	Function
⏽	Control voltage ON
AUTO	AUTO
X+	Axis direction X+
X-	Axis direction X-
Y+	Axis direction Y+
Y-	Axis direction Y-
∿	Rapid feed
⏭	Semi-automatic start
	Feed potentiometer



Axis direction keys

It is possible to move the X and Y axes via the axis direction keys. If the final position is reached for one of the axes, the corresponding alignment key illuminates.

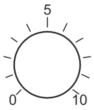
The axis is moved as long as the corresponding axis direction key is pressed. The axis stops immediately when the axis direction key is released. It is possible to move various axes at the same time.



Rapid feed

The rapid feed key illuminates, if the power supply of the motor table control is not guaranteed.

If the rapid feed key is pressed simultaneously with an axis direction key, the selected axis moves in the rapid feed.



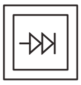
Feed potentiometer

It is possible to set the traversing speed (feed) via the feed potentiometer (10-1000 mm/min).

AUTO

It is possible to automatically position the X and Y axes in the POSITIP operating mode **EXECUTE PROGRAM**. In order to achieve this, the AUTO key must be activated by pressing it. The key illuminates.

By repeatedly pressing the AUTO key, the automatic positioning is released. The key illumination goes off.

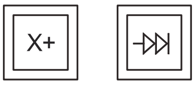


Semi-automatic start

With the aid of the semi-automatic start key, a positioning process can be started in the POSITIP operating mode **EXECUTE PROGRAM**, in the POSITIP operating modes **PROGRAMM RUN SINGLE BLOCK** or **PROGRAM RUN AUTOMATIC**, here one must make sure that the AUTO key illuminates.

In the POSITIP operating mode **PROGRAM RUN SINGLE BLOCK**, the next block must be called after the positioning process has been executed at the POSITIP. In the POSITIP operating mode **PROGRAM RUN AUTOMATIC**, the POSITIP automatically displays the next program block as soon as the programmed position has been reached.

In the other POSTIP operating modes **ACTUAL VALUE**, **DISTANCE-TO-GO** and **PROGRAMMING AND EDITING**, the X and Y axes move to the set zero position when the semi-automatic key has been actuated.



Continuous operation

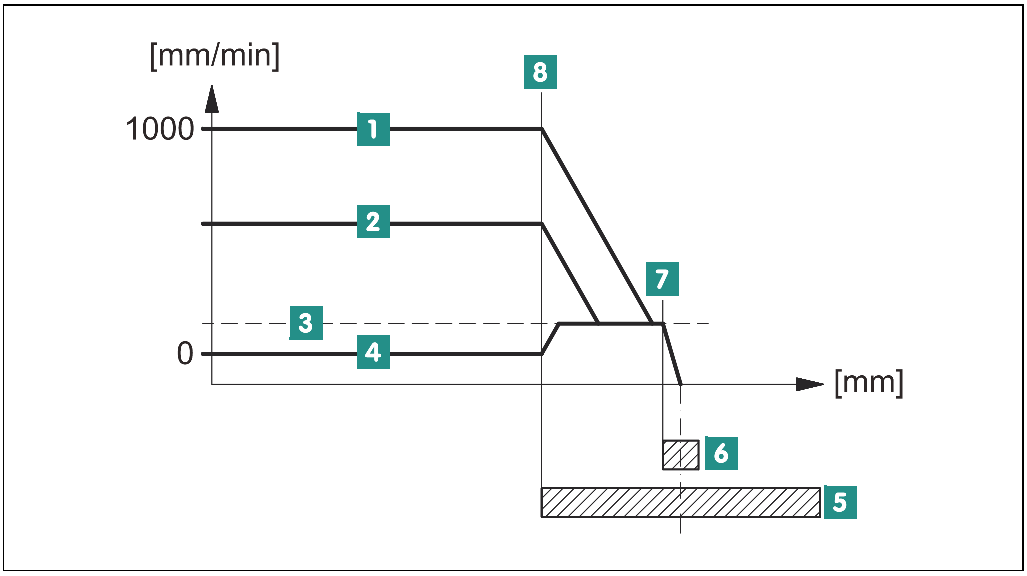
If the semi-automatic start key is pressed simultaneously with an axis direction key, the selected axis continues to move even after the key has been released. The moving axis is stopped in the following cases:

- By approaching the final position
- By repeatedly pressing the semi-automatic start key or one of the axis direction keys.
- By approaching a set zero position or a programmed position in case of active POSITIP pre-shut-off points. ***See paragraph 4.4.4.1 Pre-shut-off points.***

4.4.4.1 Pre-shut-off points

Due to the attached motors, it is possible to position the motor table in the continuous operation. Set zero positions or programmed positions can be approached automatically.

1	Rapid traverse feed
2	Potentiometer feed
3	Creep feed
4	Potentiometer feed
5	Brake window
6	Target window
7	1st pre-shut-off point
8	2nd pre-shut-off point

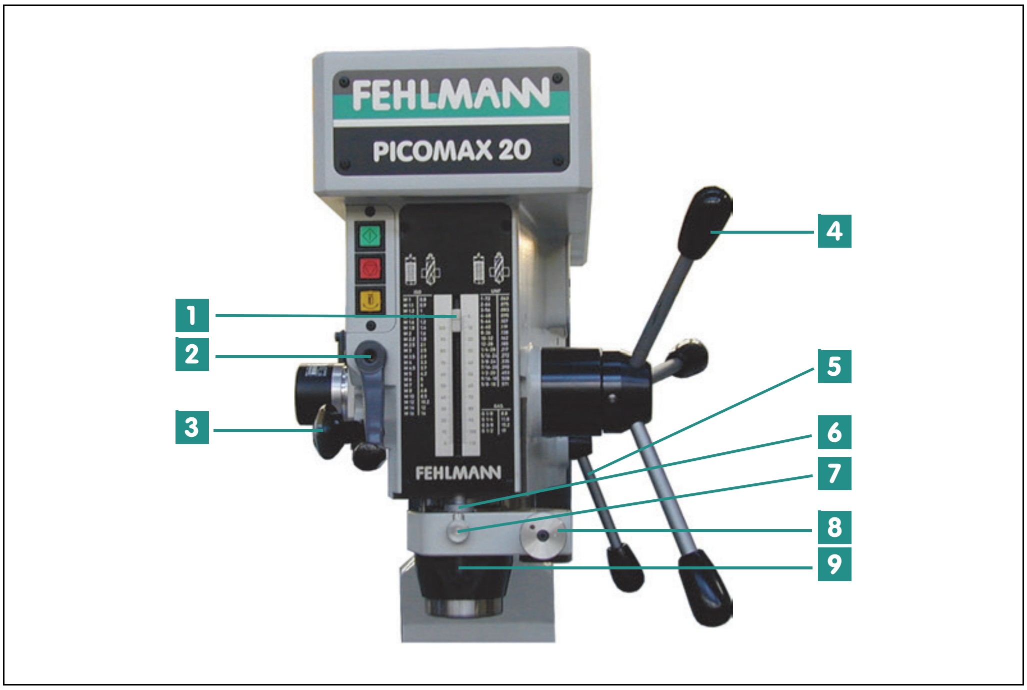


Note!

This is only guaranteed if the 1st pre-shut-off point (target window) and the 2nd pre-shut-off point (brake window) have been set correctly. Incorrect changes of the values will lead to an incorrect positioning.

4.4.5 Machine head operating elements

1	Depth pointer
2	Crankshaft journal for the height adjustment
3	Quill attachment screw
4	Drilling lever
5	Drilling head machine head
6	Depth spindle
7	Stop screw
8	Knurled knob fine depth in-feed (option)
9	Knurled knob



Drilling depth scale

The drilling depth scale is used for the precise adjustment of the drilling depth. In addition to that, the core removing hole diameters of the various thread sizes are listed.

Drilling head machine head

It is possible to clamp the machine head onto the column with the clamping lever.

Crankshaft journal for the height adjustment

With the closed crank, it is possible to adjust the clamping lever height after releasing it.

Quill attachment screw

With the star grip, it is possible to clamp the quill in any arbitrary position.

Drilling lever

The drilling lever is used for the height adjustment of the quill or of the tool. It is possible to guide the tool to the workpiece with the drilling lever.

4.4.5.1 Central stop

Depth spindle

The depth spindle is used for the precise adjustment of the drilling depth. It is equipped with a nonius (movable auxiliary scale) (1 bar: 0.1 mm)

Depth pointer

For the work spindle in the upper final position, the depth pointer shows the set drilling depth.

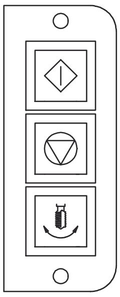
Knurled knob

The desired drilling depth is adjusted by turning the knurled knob.

Stop screw

The stop screw is used for stopping the adjusted drilling depth.

4.4.6 Machine head control panel



Key	Function
◇	Spindle ON
▽	Spindle STOP
↻	Manual change of rotation direction

Spindle ON

Switches the work spindle on.

Spindle STOP

Stops the work spindle.

Manual change of rotation direction

There is the possibility to change the rotation direction of the work spindle once per operation by manually actuating the rotation direction change key at the machine head. If this has taken place, the Z axis of quill axis must be repositioned in the initial position first so that the rotation direction can be changed again.

4.4.6.1 In-feed system turret stop (option)

The 8 separately adjustable stops on the side-mounted in-feed system turret stop can be used for limiting the in-feed. ***See paragraph 4.9 In-feed system turret stop.***

4.4.7 Machine modes

4.4.7.1 Machine mode SET-UP/MANUAL

Set-up/Manual

This machine operating mode is designed both for regular production and set-up mode. All machine functions are enabled.

STOP **Danger!**

In the machine mode SET-UP/MANUAL, the machine tool may only operated by specially trained and qualified personnel who is acquainted with the risks and hazards of chip removing machining processes.

Note!

The machine operating mode is automatically preselected after switching on the machine tool.

4.4.7.2 Machine operating mode CENTERING MAGNIFYING GLASS

Centering magnifying glass

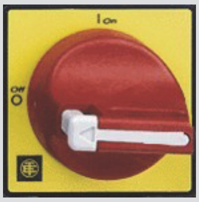
In the machine operating mode **CENTERING MAGNIFYING GLASS**, the work spindle drive is blocked and cannot be put into operation unintentionally by faulty manipulations. At the same time, the voltage for the illumination of the centering magnifying glass is switched on.

4.5 Operation of the machine tool

Before switching on the machine tool, it must be ensured that:

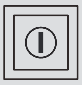
- the EMERGENCY STOP button is not pressed.
- the Z axis or quill axis is located outside the hazard area due to an interference after traversing machine reference points.

4.5.1 Machine tool start



Switch on the machine tool.

After switching on the main switch, P20 is displayed on the digital display of the machine control panel.



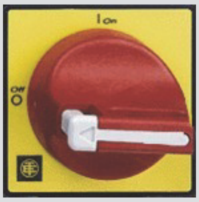
Switch on the control voltage.

Note!

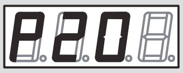
The control voltage cannot be switched on with the EMERGENCY STOP button pressed.

The EMERGENCY STOP button must be unlocked (reset).

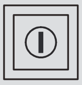
4.5.2 Machine tool start (option ND 780)



Switch on the machine tool.



After switching on the main switch, P20 is displayed on the digital display of the machine control panel.



Switch on the control voltage.

Note!

The control voltage cannot be switched on with the EMERGENCY STOP button pressed.

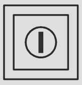
The EMERGENCY STOP button must be unlocked (reset).

Delete the message by pressing a key.

4.5.3 Machine tool start (option POSITIP 880)

Switch on the machine tool.

After switching on the main switch, P20 is displayed on the digital display of the machine control panel.



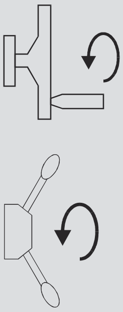
Switch on the control voltage.

Note!

The control voltage cannot be switched on with the EMERGENCY STOP button pressed.

The EMERGENCY STOP button must be unlocked (reset).

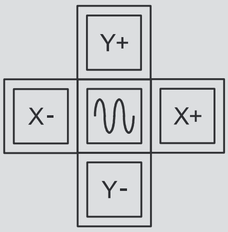
Delete the message by pressing a key.



Approach the machine reference point of each axis.

- The X and Y axes are moved manually via the hand wheels.
- The Z axis of quill axis is moved manually by 50 mm via the drill lever.

4.5.4 Moving the individual axes (option POSITIP 880)



Using the axis direction keys, the axes are moved at normal feedrate and in rapid feed mode.

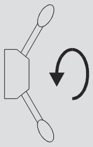
Move the axes to their final positions until the corresponding axis direction key illuminates.

4.5.5 Switching off the machine tool

Position X and Y axis in the center of their traveling ranges.

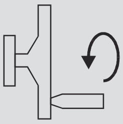
Switch off the machine tool.

4.5.6 Moving the z axis or quill axis



The Z axis or quill axis is moved manually via the drilling lever.

4.5.7 Moving the machine head



The machine head is moved manually via the mechanical hand crank.

4.5.8 Tool change

STOP

Danger!

Never catch at rotating tools!

Tool change must be performed with spindle drive switched off. Wait until the work spindle has come to a complete standstill.

Hold the clamped tool with the left hand and push the drilling lever until the z axis or quill axis stops its upward movement at the fixed stop. In doing so, the three balls holding the tool are released and the knock-out rod inside the work spindle ejects the tool.

Clean the tool holder and the spindle taper during inserting the new tool. In order to avoid dirt accumulation in the spindle taper, it is advisable to insert a tool holder in the work spindle.

Caution!

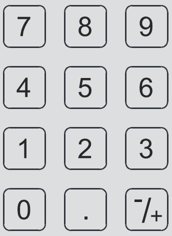
A contaminated or improperly handled tool holder may affect the accuracy of the machine tool.

The cleanliness and correct handling and operation of the machine tool is of the highest priority.

4.5.9 Reference point setting (option ND 780)

Approach the desired position.

Select axis (e.g. X axis)



Enter the value via the numerical key pad

ENTER

ENTER
Acknowledge and enter the input value

4.5.10 Reference point setting (option POSITIP 880)

└

ACTUAL VALUE

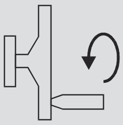
DATUM

Select Softkey DATUM

The cursor is now on the field REFERENCE POINT NUMBER.

7	8	9
4	5	6
1	2	3
0	.	-/+

Enter the reference point number via the numerical key pad



Approach the desired position on the X, Y, Z axis

●

Select axis (e.g. X axis)

7	8	9
4	5	6
1	2	3
0	.	-/+

Enter the value via the numerical key pad

ENT

ENTER
Acknowledge and enter the input value

USE

Repeat the process for the other axes.

Select Softkey USE.

Note!

Setting the reference point is very simple when using the edge probe.

For detailed information, see HEIDENHAIN operating manual.

4.5.11 Drilling/milling

4.5.11.1 Drilling/milling, clockwise rotation

Select the quill axis mode **DRILLING/MILLING** .

Select the spindle speed. ***See paragraph 4.4.3.1 Speed generator.***

Position the tool via mechanic hand wheels or axis direction keys (option POSITIP 880) in the X and the Y axis direction.

Set the machining depth via the central stop, the in-feed system turret stop (option) or the position display (option POSITIP 880).

Start the work spindle

Switch on the coolant supply, if necessary

Execute the machining operation

4.5.11.2 Drilling/milling, anti-clockwise rotation

Drilling/milling, activate anti-clockwise rotation

Select quill axis mode
THREAD CUTTING, CLOCKWISE ROTATION.

Start work spindle

Execute the machining operation

When reaching the machining depth via the central stop or via the in-feed system turret stop (option), the work spindle rotation direction changes.

Stop the work spindle

Select the quill axis mode **DRILLING/MILLING** .

The machine tool is now in the quill axis mode **DRILLING/MILLING, ANTI-CLOCKWISE ROTATION**.

Drilling/milling, deactivate anti-clockwise rotation

Select quill axis mode
THREAD CUTTING, CLOCKWISE ROTATION.

Start work spindle

Execute the machining operation

When reaching the machining depth via the central stop or via the in-feed system turret stop (option), the work spindle rotation direction changes.

4.5.11.3 Manual milling

Select the quill axis mode **DRILLING/MILLING** .

Select the spindle speed. ***See paragraph 4.4.3.1 Speed generator.***

Approach the start point via mechanic hand wheels or with the axis direction keys (option POSITIP 880).

Set the machining depth via the in-feed system fine depth in-feed (option) or via the position display (option POSITIP 880). Here, clamp the quill via the clamping lever.

Start the work spindle

Switch on the coolant supply

Clamp the clamping lever for the non-movable axis.

Approach the final point via the mechanic hand wheels.

4.5.11.4 Controlled milling (option POSITIP 880)

Select the quill axis mode **DRILLING/MILLING** .

Select the spindle speed. ***See paragraph 4.4.3.1 Speed generator.***

Approach the start point via mechanic hand wheels or with the axis direction keys (option POSITIP 880).

Set the machining depth via the in-feed system fine depth in-feed (option) or via the position display (option POSITIP 880). Here, clamp the quill via the clamping lever.

PROGRAMMING

PROGRAMMING FEATURES...

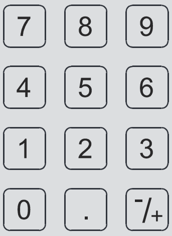
Select Softkey PROGRAMMING FEATURES...

MORE...

Select Softkey MORE...

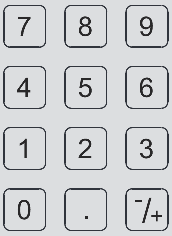
LINE

Select Softkey LINE



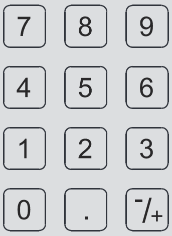
Enter the start point X1 via the numerical keypad

ENTER
Take over the input



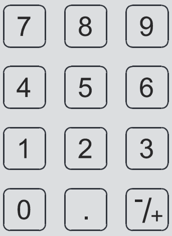
Enter the start point Y1 via the numerical keypad

ENTER
Take over the input



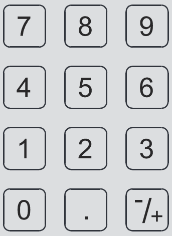
Enter the end point X2 via the numerical keypad

ENTER
Take over the input



Enter the end point Y2 via the numerical keypad

ENTER
Take over the input



Enter the cutting depth via the numerical keypad

ENTER
Take over the input

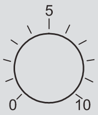
Enter the tool offset

ENTER
Take over the input

Select Softkey USE

AUTO

Press the key if it does not illuminate.



Set the feed

Start the work spindle

Switch on the coolant supply, if necessary

Start the program

The machine tool moves to the set end position.

The key illumination goes off.

4.5.11.5 Manual arc milling (option POSITIP 880)

Select the quill axis mode **DRILLING/MILLING** .

Select the spindle speed. ***See paragraph 4.4.3.1 Speed generator.***

Approach the start point via mechanic hand wheels or with the axis direction keys (option POSITIP 880).

Set the machining depth via the in-feed system fine depth in-feed (option) or via the position display (option POSITIP 880). Here, clamp the quill via the clamping lever.

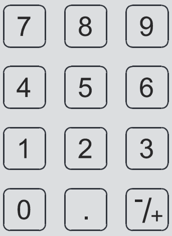
PROGRAMMING

PROGRAMMING FEATURES...

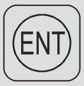
Select Softkey PROGRAMMING FEATURES...

ARC

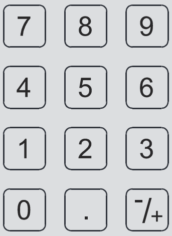
Select Softkey ARC



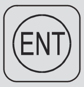
Enter the start point X1 via the numerical keypad



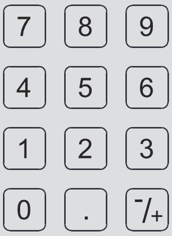
ENTER
Take over the input



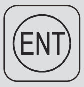
Enter the start point Y1 via the numerical keypad



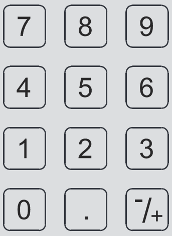
ENTER
Take over the input



Enter the end point X2 via the numerical keypad

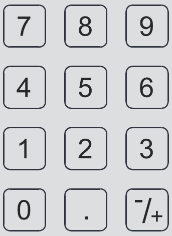


ENTER
Take over the input



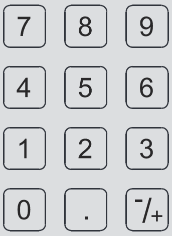
Enter the end point Y2 via the numerical keypad

ENTER
Take over the input



Enter the cutting depth via the numerical keypad

ENTER
Take over the input



Enter the radius via the numerical keypad

ARC < 180° ARC > 180°	Select the desired softkey.
ENT	**ENTER** Take over the input
	Enter the arc direction
ENT	**ENTER** Take over the input
	Enter the tool offset
ENT	**ENTER** Take over the input
USE	Select Softkey USE
▶	**EXECUTE PROGRAM**

AUTOMATIC

Select POSITIP mode **AUTOMATIC**

VIEW

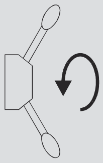
Select the softkey VIEW to display the NC program.

VIEW

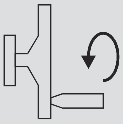
Select the softkey VIEW to display the graphic.

Start the work spindle

Switch on the coolant supply, if necessary



Move the Z axis or the quill axis manually via the drilling lever.



Slowly move the X and Y axes manually via the mechanical hand wheels according to the displayed graphic.

For detailed information, see HEIDENHAIN operating manual.

4.5.12 Thread cutting

4.5.12.1 Thread cutting, clockwise rotation/anti-clockwise rotation

Select quill axis mode **THREAD CUTTING** .

Select spindle speed. ***See paragraph 4.4.3.1 Speed generator.***

Position the tool via mechanic hand wheels or axis direction keys (option POSITIP 880) in the X and the Y axis direction.

Set the machining depth via the central stop or via the in-feed system turret stop (option).

Start work spindle

Switch on the coolant supply, if necessary

Execute the machining operation

When reaching the machining depth via the central stop or via the in-feed system turret stop (option), the work spindle rotation direction changes.

4.5.13 Starting an NC program (Option POSITIP 880)

EXECUTE PROGRAM

FILE OPERATIONS...

Select Softkey FILE OBERATIONS...

LOAD

Select Softkey LOAD

7 8 9
4 5 6
1 2 3
0 . ⁻/₊

Select an already existing NC program by entering the appropriate program number via the numerical key pad

or

↑ ↓

select an already existing NC program using the arrow keys.

LOAD

Select Softkey LOAD

With the axes, move to the specified positions. When the specified position is reached, its color changes to grey.

PROGRAMMING

SINGLE BLOCK

AUTOMATIC

Select POSITIP mode **SINGLE BLOCK** or POSITIP mode **AUTOMATIC**.

AUTO

Press the key if it does not illuminate.

Start the program

For detailed information, see HEIDENHAIN operating manual.

4.6 Z axis or quill axis

4.6.1 Configuration and function principle

The Z axis or quill axis is a positioning axis that is moved via a gearing. The quill axis returns to its home position via return springs.

4.6.2 Quill axis modes

4.6.2.1 Quill axis mode DRILLING/MILLING

Preselect drilling/milling

The quill axis mode **DRILLING/MILLING** enables the entire speed range.

The speed is set via the pre-selection keys at the feed generator or variably.

> **Note!**
>
> **The quill axis mode DRILLING/MILLING is automatically preselected after switching on the machine tool.**

4.6.2.2 Quill axis mode THREAD CUTTING

Preselect thread cutting, clockwise rotation
Preselect thread cutting, counterclockwise rotation

Note!

If the work spindle moves, it is stopped automatically by selecting the machine operating mode THREAD CUTTING.

If the quill axis mode **THREAD CUTTING** has been selected, the speed is automatically limited to max. 1000 min^{-1}.

Note!

For thread cutting, FEHLMANN AG recommends the use of special tool holders with length compensation and slipping clutch.

For detailed information, see supplementary folder "Accessory catalogue FEHLMANN AG".

4.6.3 Maintenance

A special maintenance for the Z axis or quill axis is not necessary.

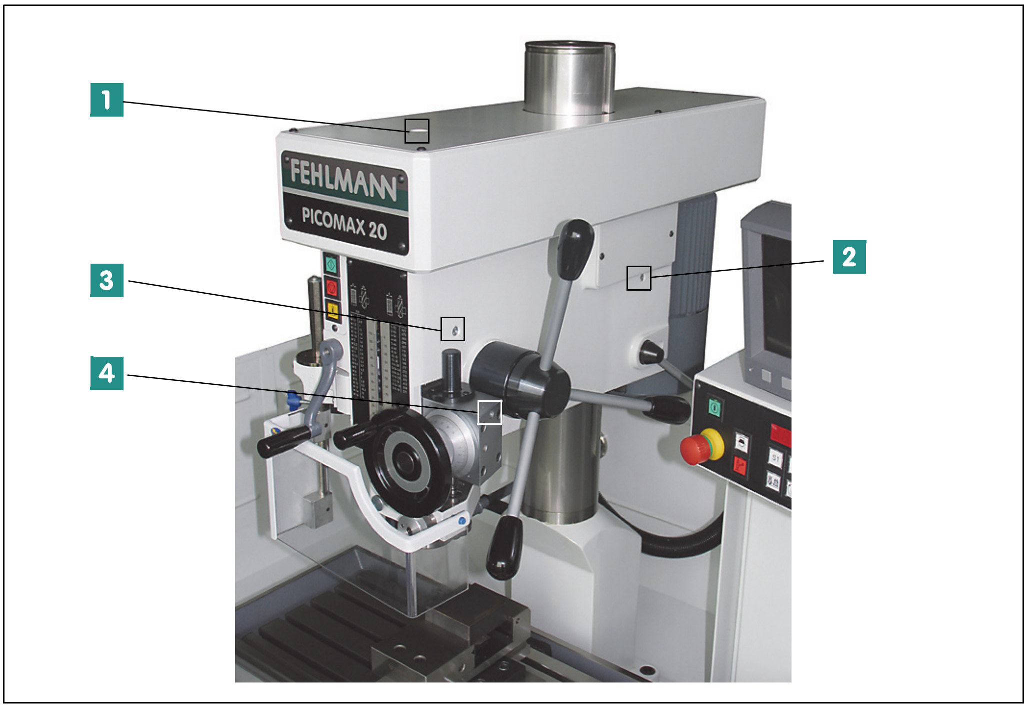
4.7 Machine head

4.7.1 Maintenance

4.7.1.1 Re-greasing of the lubricating points

Lubrication points:

1	Drill spindle
2	Pillar guide
3	Quill
4	Fine depth in-feed



Re-greasing of the lubricating points	
Interval	once per week

The machine tool must be re-greased at the machine head via the delivered oil press.

Lubricating oil	
Manufacturer	Mobil
Type	Vactra Oil No. 1
FEHLMANN order number	E2746-100-00

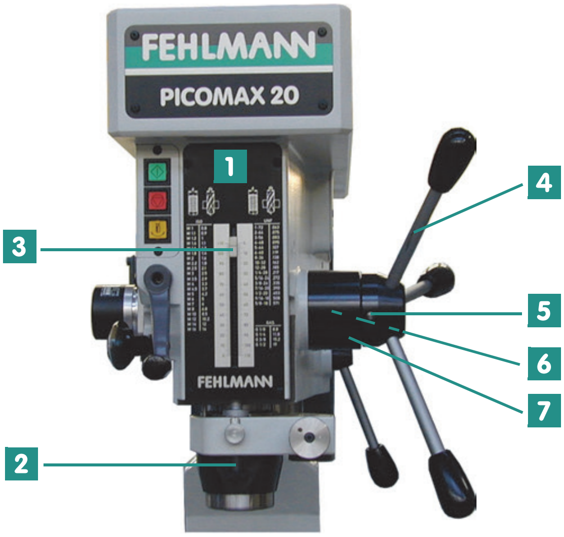
Caution!

Only this oil or an equivalent oil may be refilled. ***See paragraph 4.27 Lubricant comparison table.***

4.7.2 Service

4.7.2.1 Replacing the return spring

1	Plate
2	Knurled knob
3	Depth pointer
4	Drilling lever
5	Taper pin
6	Set screw
7	Spring case



Remove the plate and dispose of it carefully in order to prevent scratches.

Remove depth pointer from the thread spindle of the central stop by turning the knurled knob.

Hold the quill with the work spindle with the left hand so that it does not fall out. Turn the drilling lever to the front with the right hand until the quill gearing no longer meshes with the quill pinion. Do not let go off the drilling lever and turn it back slowly until the spring has been released. Carefully pull out the quill with the work spindle and dispose of it.

Tap out the taper pin and pull out the drilling lever. Loosen the set screw and pull out the spring housing. Loosen the old spring, take it out and insert a new spring.

Mount the spring case again, screw in the set screw and tighten it. Mount the drilling lever and insert the taper pin.

Carefully insert the quill with the work spindle, move in the quill groove into the wedge, slightly press it in upward direction, but make sure that the quill gearing does not mesh with the quill pinion.

Tension the return spring by turning the drilling lever three times in anti-clockwise direction. This corresponds to the normal return spring tension.

Press the quill in upward direction and make sure the quill pinion meshes with the quill toothing via the drilling lever. Move slightly in upward direction until a stop is felt. Slowly rotate work spindle until the spline shaft meshes with the spline ball hub.

Insert depth pointer.

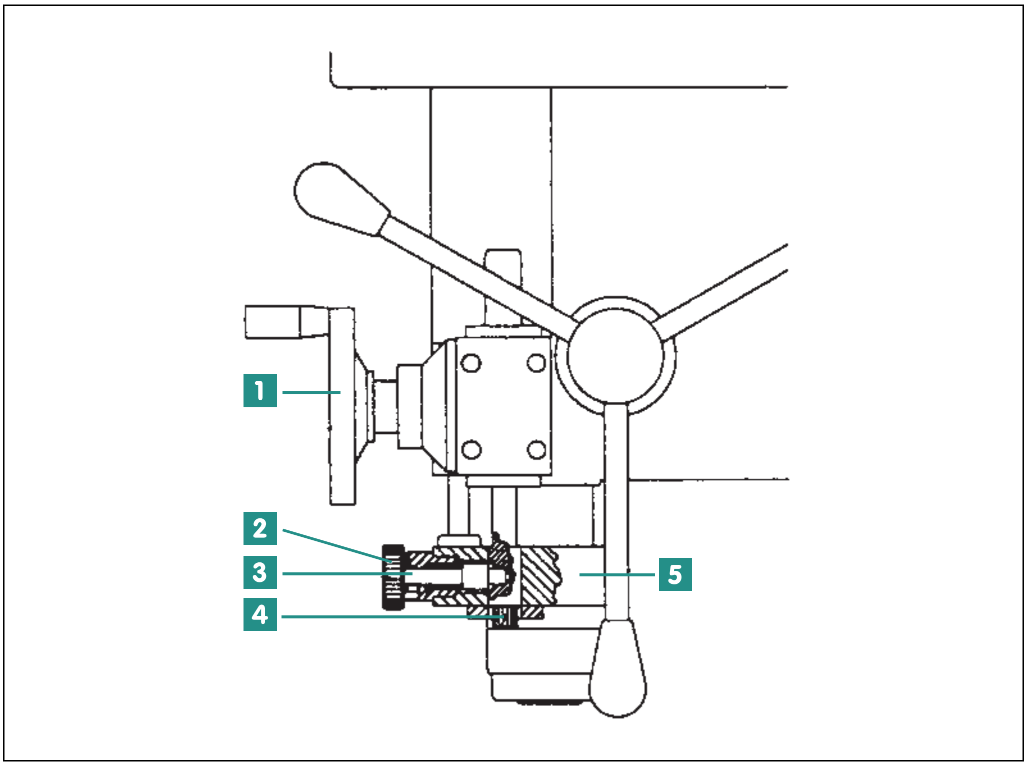
Mount plate.

4.8 In-feed system fine depth in-feed

4.8.1 Configuration and function principle

With the in-feed system fine depth in-feed, preferably milling and boring work can be executed.

1	Hand wheel
2	Knurled knob
3	Lock pin
4	Threaded spindle
5	Quill flange



Switching on the fine depth adjustment

Move the quill flange slightly in downward direction with the drilling lever.

Adjust the bore in forward direction at the knurled head of the threaded spindle.

Move the quill flange in upward direction with the drilling lever until the upper flange edge us flush with the initial threaded spindle edge.

Engage the lock pin in the threaded spindle bore by rotating the knurled knob in clockwise direction.

The quill flange is now connected to the threaded spindle and can be moved via the hand wheel.

Switching off the fine depth in-feed adjustment

Warning!

To switch off the fine depth in-feed, the quill flange must be rotated to the upper starting position via the hand wheel.

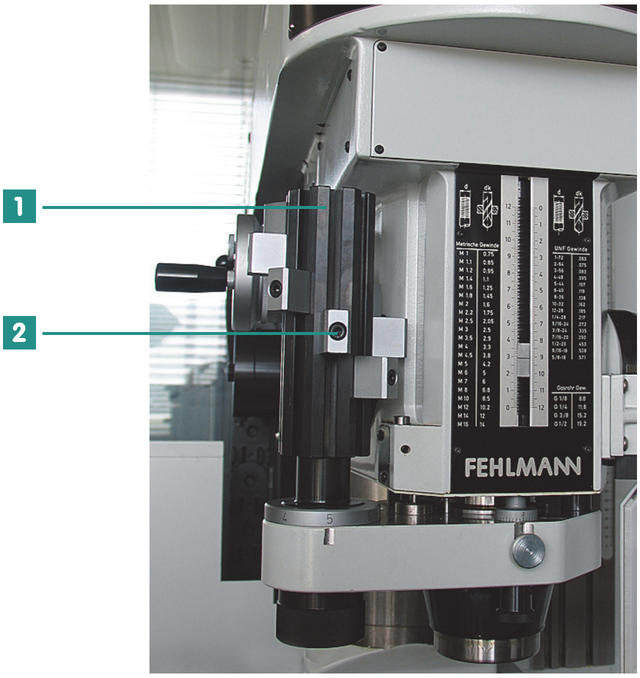
The threaded spindle must not protrude under the quill flange when the fine depth in-feed is not active.

4.9 In-feed system turret stop

4.9.1 Configuration and function principle

With the in-feed system turret stop, especially drilling and thread cutting works can be executed quickly and precisely.

1	In-feed system turret stop
2	Stops



4.9.2 Maintenance

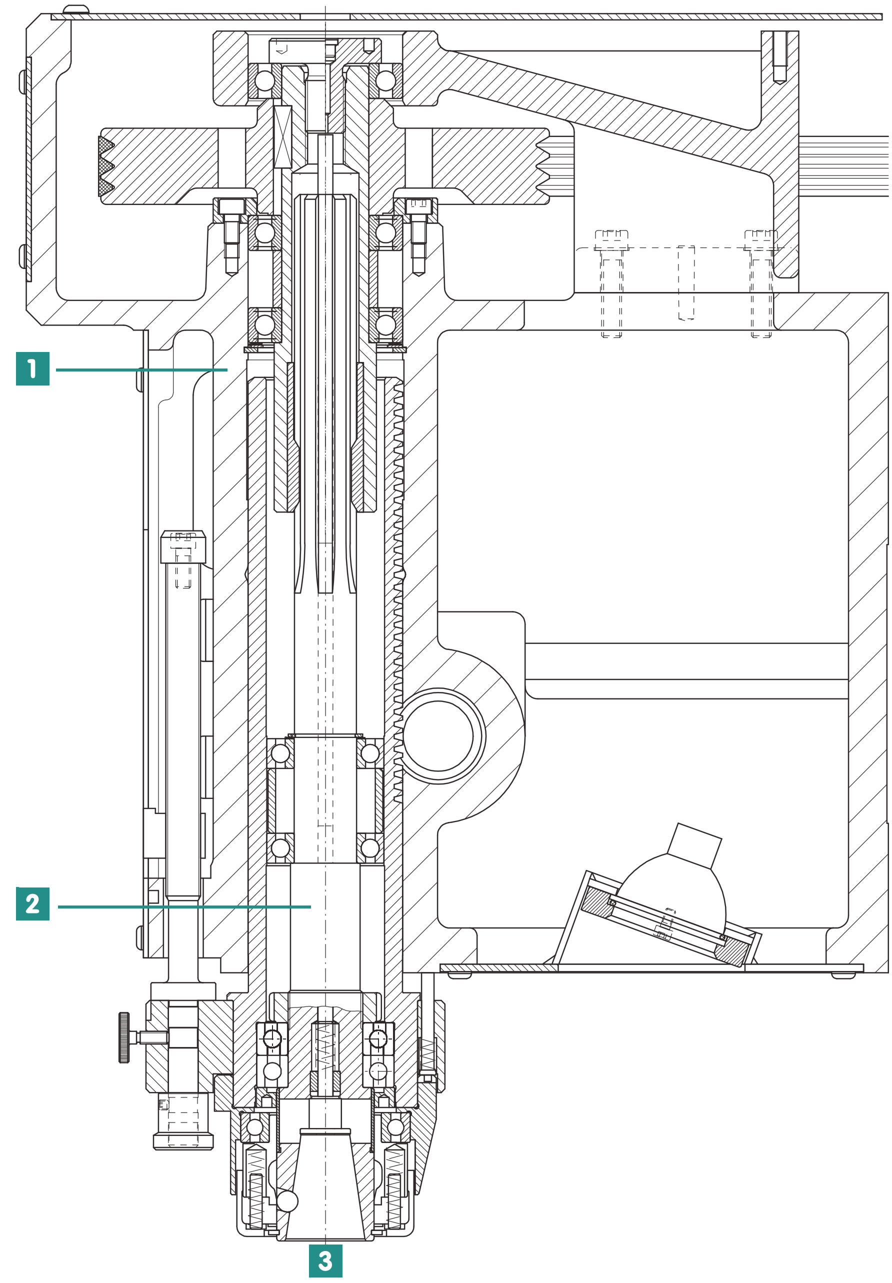
No special maintenance work is necessary for the in-feed system turret stop.

4.10 Work spindle

4.10.1 Configuration and function principle

The integrated work spindle is a rigid, vertical drilling spindle with grease lubrication which have both been designed for milling work and for thread cutting.

1	Machine head housing
2	Drill spindle
3	Tool taper



4.10.2 Operation with work spindle and coolant

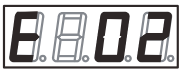
Spindle ON

Starts the work spindle in the pre-selected quill axis mode with the input speed.

Caution!

If the work spindle is started or stopped too often, this may lead to a frequency converter overload or to a braking resistor overheating.

The digital display of the machine control panel displays this with the following error message:

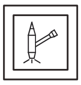


Spindle STOP.

The work spindle is stopped in the pre-selected quill axis mode without orientation.

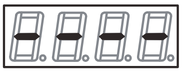
Manual change of rotation direction

There is the possibility to change the work spindle rotation direction once per machining operation at the machine head. If this has taken place, the Z axis of quill axis must be repositioned in the initial position first so that the rotation direction can be changed again.



Centring magnifying glass

By pressing the centring magnifying glass key, a switching on of the work spindle is prevented and at the same time, the voltage for the centring magnifying glass illumination is switched on. The key illuminates. When one tries to start the work spindle, the following error message will be displayed on the digital display of the machine control panel:



This function is also used simultaneously as spindle interrupt.

Danger!

During setting works using a dial gauge or a centering magnifying glass, the centering magnifying glass key must always be activated.

By continuously pressing the centring magnifying glass key, the spindle interrupt is released. The key illumination goes off.

Coolant supply ON/OFF

With this key, the machine auxiliary mode **COOLANT SUPPLY ON/OFF** is switched on. If the coolant is to be supplied only when the work spindle rotates, the coolant supply ON/OFF key is to be actuated quickly once only. The key flashes.

By pressing the coolant ON/OFF key for a prolonged period of time, the coolant supply is switched on continuously. The key illuminates.

4.10.3 Maintenance

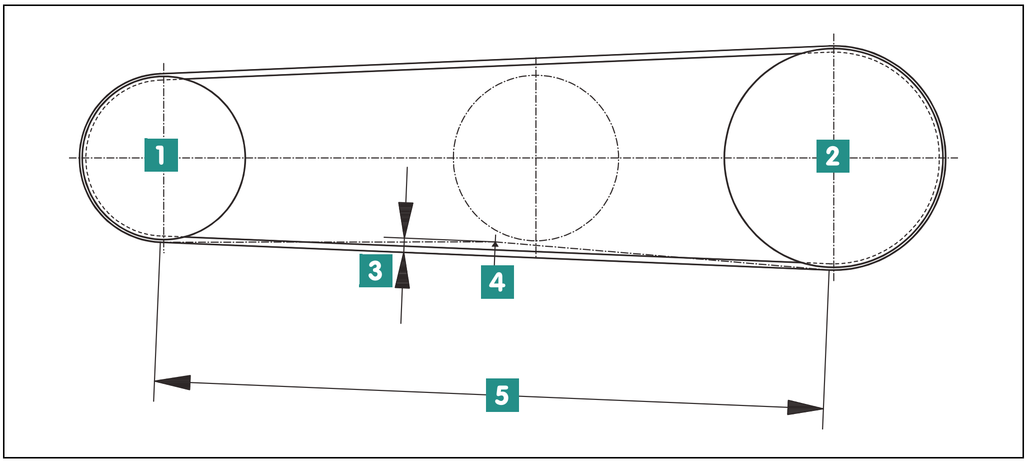
4.10.3.1 Belt drive

Inspection of the belt tension	
Interval	once per year

For a maximum economy and life of the V-belt drive, a correct mounting and re-tensioning is under all circumstances necessary.

The V-belt drive tension is an important factor. A too low tensioning leads to a belt slip with the consequence of an early belt defect. An increased tension means an increased belt stress which reduces the belt life.

Inspection of the correct belt tension



1	Work spindle
2	Motor
3	Deflection
4	Deflection force
5	Drum length 507 mm

Measures the deflection force with a voltage detector in the middle of the drum length.

This voltage detector consists of a calibrated spring which on the one hand shows the deflection and on the other hand shows the deflection force. The measuring values are indicated on each scale with the aid of an O-ring.

Set the deflection to 7.9 mm on the ditance scale via the lower O-ring. The upper O-ring should be in the zero position on the bending scale.

Mount the voltage detector in the middle and at right angles to the drum length. Use a sufficient force in order to bend the belt until it reaches the dimension set on the low scale. A steel ruler or belt led across the belt makes it easy to read off the values.

The upper O-ring has now slipt off the upper scale and displays the bending force. (Read off at the upper O-ring side.)

- The bending fore when newly mounting a belt is 28–32 N
- The bending force in case of re-tensioning is 23–28 N

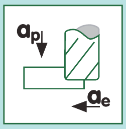
Precision V-belt	
Manufacturer	LAESSER AG
Type	Polyflex precision V-belt 3/7M-1500JB
FEHLMANN order number	E3859-150-10

4.10.4 Error diagnosis

If any malfunctions occur to the work spindle, the settings at the spindle drive must be checked. ***See paragraph 4.14.4 Error diagnosis.***

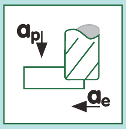
4.11 Cutting value tables

4.11.1 Roughing cutter

						CK 45 1.1191		Aluminium	
Tool	**Number**	**d_1**	**z**	**a_p**	**a_e**	**n**	**v_f**	**n**	**v_f**
Roughing cutter HSS	U3490.100	32	6	6	24	450	130	–	–
Roughing cutter HSS	U3490.110	40	8	6	30	360	200	–	–
Roughing cutter HSS	U0640.610	16	4	16	8	450	180	–	–
		–	–	12	16	700	200	–	–
Roughing cutter HSS	U0640.501	12	4	12	6	1060	320	–	–
		–	–	9	12	930	200	–	–
Roughing cutter HSS	U0640.450	10	4	10	5	1270	230	–	–
		–	–	7	10	1120	130	–	–
Roughing cutter HSS	U0640.402	8	4	8	4	1600	220	–	–
		–	–	6	8	1400	110	–	–
Roughing cutter HSS	U0640.300	6	3	6	3	2100	160	–	–
		–	–	4	6	1850	110	–	–
Roughing cutter HM	U5331.450	10	3	10	5	2230	370	2700	450
		–	–	5	10	1900	230	2380	290
Roughing cutter HM	U5331.391	8	3	8	4	2780	380	3380	450
		–	–	4	8	2380	250	2980	310
Roughing cutter HM	U5331.300	6	3	6	3	3700	390	4500	470
		–	–	3	6	3180	240	3980	300
Roughing cutter HM	U5331.220	4	3	5	2.5	5570	250	6760	300
		–	–	2.5	5	4780	210	5970	270
Roughing cutter HM	U5331.180	3	3	3	1.5	7400	220	–	–
		–	–	1.5	3	6300	200	–	–

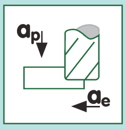
d_1 = Tooth diameter, **z** = Number of tooths, **a_p** = Axial ajustment, **a_e** = Radial ajustment,
n = Speed (approximate value), **v_f** = Feed rate mm/min (approximate value)

4.11.2 Finishing cutter

						CK 45 1.1191		Aluminium	
Tool	**Number**	**d_1**	**z**	**a_p**	**a_e**	**n**	**v_f**	**n**	**v_f**
Finishing cutter HM	U5340.501	12	4	18	1	1850	300	–	–
Finishing cutter HM	U5340.450	10	4	15	1	2200	300	–	–
Finishing cutter HM	U5340.391	8	4	12	0.8	2700	280	–	–
Finishing cutter HM	U5340.300	6	4	9	0.6	3700	280	–	–

d_1 = Tooth diameter, **z** = Number of tooths, **a_p** = Axial ajustment, **a_e** = Radial ajustment,
n = Speed (approximate value), **v_f** = Feed rate mm/min (approximate value)

4.11.3 Tipped milling cutter

						CK 45 1.1191		Aluminium	
Tool	**Number**	**d_1**	**z**	**a_p**	**a_e**	**n**	**v_f**	**n**	**v_f**
Tipped milling cutter	5914-001	40	5	2	30	900	480	1900	1000

d_1 = Tooth diameter, **z** = Number of tooths, **a_p** = Axial ajustment, **a_e** = Radial ajustment,
n = Speed (approximate value), **v_f** = Feed rate mm/min (approximate value)

4.11.4 Tap

				a_p a_e		CK 45 1.1191		Aluminium	
Tool	**Number**	**d_1**	**z**	**a_p**	**a_e**	**n**	**v_f**	**n**	**v_f**
Tap HSS	E0211.240	M12	–	–	–	210	–	320	–
Tap HSS	E0210.174	M10	–	–	–	260	–	380	–
Tap HSS	E0210.160	M8	–	–	–	320	–	480	–
Tap HSS	E0210.088	M6	–	–	–	430	–	640	–
Tap HSS	E0210.084	M5	–	–	–	500	–	780	–
Tap HSS	E0210.058	M4	–	–	–	640	–	950	–
Tap HSS	E0210.044	M3	–	–	–	850	–	1200	–

d_1 = Tooth diameter, **z** = Number of tooths, **a_p** = Axial ajustment, **a_e** = Radial ajustment,
n = Speed (approximate value), **v_f** = Feed rate mm/min (approximate value)

4.12 Measuring systems (option)

4.12.1 Configuration and function principle

The machine tool is equipped with its own measuring system for every axis; each measuring system essentially comprises one glass scale and the related probe head. Depending on the kind of installation, one differentiates between direct and indirect measuring system.

4.12.2 Maintenance

No special maintenance for the measuring systems is necessary.

4.12.3 Service

The installation place and humid environmental conditions may affect the function of the measuring systems.

Possible error causes:

- Glass scale contaminated or damaged
- Probe head contaminated or defective
- Damaged cable
- Measuring system input in the logic unit of the control defective

If it is not possible to remove the malfunctions by cleaning the glass scale or the sampling head or if damages or defects continue to exist, the affected measuring system must be changed.

4.13 Drive conception

4.13.1 Configuration and function principle

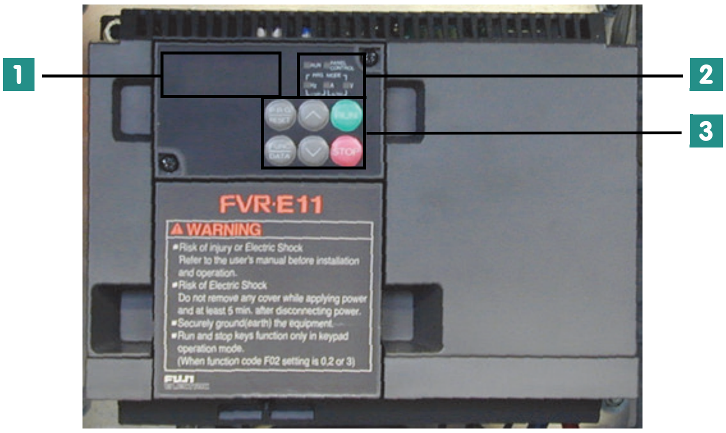
Both the spindle drive is equipped with a frequency converter. ***See paragraph 4.14 Frequency converter FVR-E11S-4EN.***

The X and the Y axis of the machine tool are controlled via an axis amplifier. ***See paragraph 4.15 Axis amplifier (option POSITIP 855).***

4.14 Frequency converter FVR-E11S-4EN

4.14.1 Configuration and function principle

1 Digital display
2 Unit and operating mode display
3 Removable operator station


1
2
3
RESET
RUN
FUNC DATA
STOP
FVR·E11
⚠ WARNING
•Risk of injury or Electric Shock
Refer to the user's manual before installation and operation.
•Risk of Electric Shock
Do not remove any cover while applying power and at least 5 min. after disconnecting power.
•Securely ground(earth) the equipment.
•Run and stop keys function only in keypad operation mode.
(When function code F02 setting is 0,2 or 3)
FUJI

For detailed information, please see supplementary folder "Auxiliary Devices".

4.14.2 Maintenance

For detailed information, please see supplementary folder "Auxiliary Devices".

4.14.3 Service

For detailed information, please see supplementary folder "Auxiliary Devices".

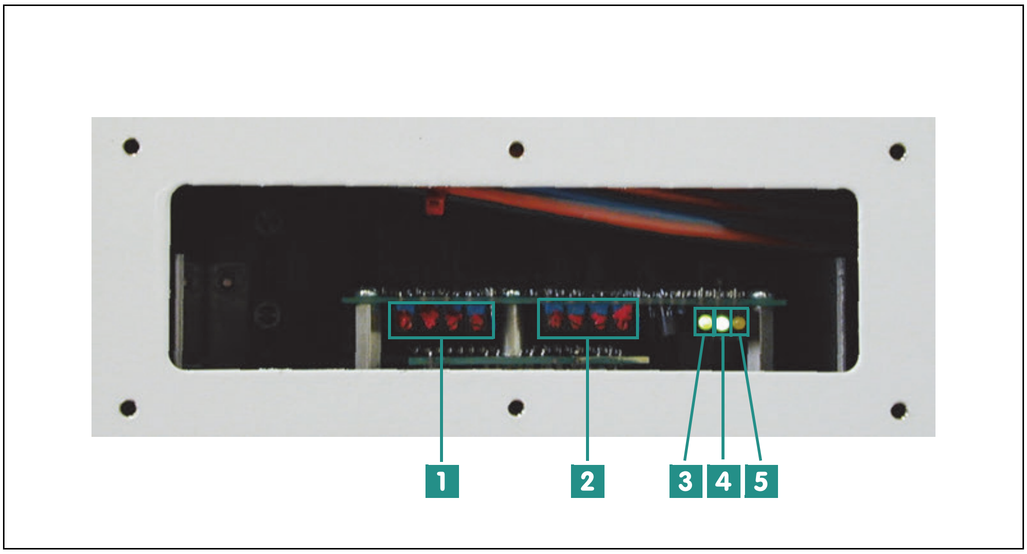
4.14.4 Error diagnosis

For detailed information, please see supplementary folder "Auxiliary Devices".

4.15 Axis amplifier (option POSITIP 855)

4.15.1 Configuration and function principle

1 X axis potentiometer
2 Y axis potentiometer
3 LED no-error-display (green)
4 LED in operation (green)
5 LED overtemperature (yellow)



4.15.2 Maintenance

No special maintenance is necessary for the axis amplifier.

4.15.3 Service

No special service is necessary for the axis amplifier.

Danger!

The axis amplifier stands under high voltage (> 60 VDC). Do not touch the circuit board.

Caution!

The potentiometer for the X and Y axes must not be adjusted.

4.15.4 Error diagnosis

If the LED overtemperature illuminates, switch off the machine tool in accordance with the regulations and let it cool down. Start the machine tool again.

Note!

If the error occurs again or if one of the LED displays of the X or Y axis illuminates in red, please contact the FEHLMANN AG customer service.

4.16 Coordinate table (option)

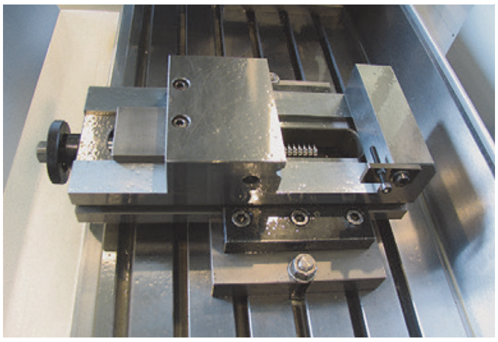
4.16.1 Use of vices with a large clamping force

When using vices with a large clamping force, it must be taken into account that the vice does not pass on any deformations to the clamping table. Deformations at the clamping table significantly increase the feed force of the individual coordinate axes. This can lead to damages on the guides (seizing) and to overload of each axis motor.

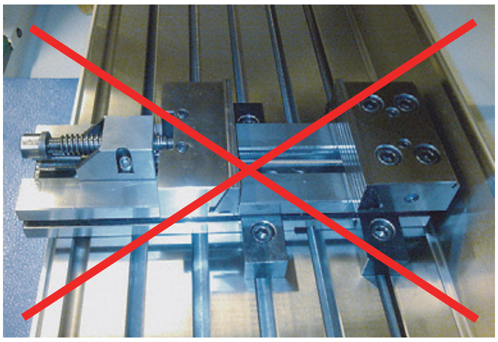
Caution!

In general, vices must not be used without intermediate plate. Always use vices which have been tested and approved by FEHLMANN AG.

Correctly assembled vice



Incorrectly assembled vice



4.16.2 Maintenance

4.16.2.1 Dove tail guides and protective devices

Check dove tail guides and protective devices and clean them if necessary	
Interval	once per month

Re-lubricate dove tail guides	
Interval	once per week

The X and Y axes are re-lubricated via the enclosed oil press.

Lubricating oil	
Manufacturer	Mobil
Type	Vactra Oil No. 1
FEHLMANN order number	E2746-100-00

Caution!

Only this oil or an equivalent oil may be refilled. *See paragraph 4.27 Lubricant comparison table.*

4.17 Fan control cabinet

4.17.1 Configuration and function principle

A or several fans are installed at the control cabinet with outlet filter for cooling the electronic components. This ventilation system is very important as electronic components generate heat during the operating, but are heat-sensitive at the same time.

4.17.2 Maintenance

4.17.2.1 Filter mat

Check the filter mat and blow out, if necessary	
Interval	once per month

Replace the filter mat	
Interval	once per year

Filter mat	
Type	SK 3172
FEHLMANN order number	E4265-090-70

4.18 Coolant tank

4.18.1 Configuration and function principle

The coolant flows from the machine tool through the chip screen to the coolant tank. The used immersion pump delivers the coolant back to the machine tool via coolant hoses.

4.18.2 Maintenance

4.18.2.1 Coolant level

Check the coolant level and fill up/replace the coolant	
Interval	once per week

4.19 Coolant

Due to the varying application, coolants must offer various characteristics which must be matched to the application procedure and the related procedural parameters.

The selection of the suited coolant largely depends on its application area inside the machine tool.

Note!

FEHLMANN AG can thus not give any general recommendation concerning the coolant to be used.

The selection of the suited coolant exclusively lies in the responsibility of the operator of the machine.

Caution!

Coolant is hazardous to soil and ground water.

Coolant may not be introduced to the sewage water system or soil.

Coolant must be disposed of according to legal and other regulations.

Warning!

Health risk through coolant.

Avoid skin contact with coolant.

Always wear safety glasses when handling coolant.

Caution!

In order to ensure the safe handling of the coolant, the manufacturer's instructions must be observed without fail.

4.19.1 Water-mixable coolants

FEHLMANN AG internally uses the coolant indicated in the table below. This coolant was tested by FEHLMANN AG and approved.

The local water quality may affect the functionality and property of water-mixable coolant to a high extent.

Coolant	
Manufacturer	Castrol
Type	Alusol B
Concentration	6–8%
Application	Steel, copper, aluminium
FEHLMANN order number	E2754-120-00

In order to grant the safe handling with coolant, the manufacturer's instructions must be observed without fail.

4.19.2 Non-water mixable coolants

FEHLMANN AG internally uses the coolant indicated in the table below. This coolant was tested by FEHLMANN AG and approved.

Coolant	
Manufacturer	MOTOREX
Type	SWISSCUT SPEED 100
Application	Cutting oil
Application	universal
FEHLMANN order number	E2749-000-00

STOP **Danger!**

The use of non-water mixable coolant bears an increased risk of fire and explosion.

If non-water mixable coolant is used, the manufacturer’s instructions and the general safety instructions must be observed and followed without fail.

STOP **Danger!**

Fully synthetic coolant which corrode rubber and plastic parts of the machine may not be used.

If, for technical reasons, coolant with a low flashpoint is used, measures to reduce the inflammable concentration of steam and fog in the machining area must be taken, e.g. through the use of an extraction system and explosion relief holes.

4.19.3 Maintenance

State-of-the-art machine tools put up high requirements on coolants. The maintenance and care of the coolant is therefore very important.

For the care, maintanance, and disposal of the coolant, all manufacturer’s instructions must be observed without fail.

For the sake of a safe operation of the machine tool, water-mixable coolants must be checked for the correct concentration, pH value, and germ number once per week.

Check the concentration	
Interval	once per week

Check the pH value	
Interval	once per week

Check the germ number (microorganisms, bacteria and fungi)	
Interval	once per week

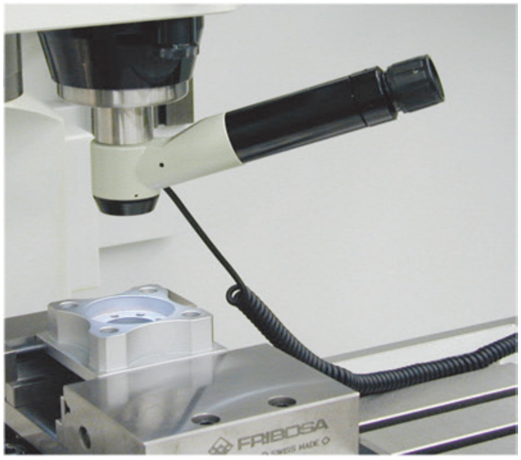
⚠ **Warning!**

FEHLMANN AG cannot be held liable for any damage (for example corrosion), caused by improper maintenance of the coolant.

4.20 Centring magnifying glass (option)

4.20.1 Configuration and function principle

It is possible to “visually” detect corners, circle centers and inaccessible edges with an enlargement of approx. 25 and to take them over directly as a workpiece zero point. Check measurements at existing workpieces are also possible.



When the centring magnifying glass is removed, the tool position monitoring system – if available – causes the spindle interrupt. ***See paragraph 4.10.2 Operation with work spindle and coolant.***

Note!

Not all machine tools are standard equipped with a plug-type connection for a centering magnifying glass.

For machine tools equipped with such a plug connection, FEHLMANN AG also delivers a prep kit or an adapter box. Our customer service department will be pleased to assist you.

For detailed information, please see supplementary folder “Auxiliary Devices”.

Centring magnifying glass SF32	
Type	SF32 / Enlargement 25x
FEHLMANN order number	7060-010

Centring magnifying glass D10	
Type	D10 / Enlargement 25x
FEHLMANN order number	7061-010

Centring magnifying glass D10 / ISO/SK 30	
Type	D10 / ISO/SK 30 / Enlargement 25x
FEHLMANN order number	8060-010

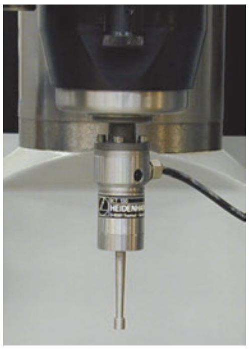
4.20.2 Maintenance

For detailed information, please see supplementary folder “Auxiliary Devices”.

4.21 3D measuring probe system KT1xx (option)

4.21.1 Configuration and function principle

With the electronic 3D measuring probe system KT1xx, it is possible to detect edges, corners and circle center points „electronically“ and take them over directly as workpiece zero poins. Check measurments on existing workpieces are also possible.



When the measuring probe is removed, the tool position monitoring system causes the spindle interrupt. ***See paragraph 4.10.2 Operation with work spindle and coolant.***

3D measuring probe system D 16-KT1xx	
Type	D 16
FEHLMANN order number	3010-870

3D measuring probe system SF32-KT1xx	
Type	SF32
FEHLMANN order number	3020-870

3D measuring probe system SF32-KT1xx	
Type	SF32
FEHLMANN order number	3051-870

3D measuring probe system SF32-KT1xx	
Type	SF32
FEHLMANN order number	3054-870

4.21.2 Maintenance

For detailed information, please see supplementary folder "Auxiliary Devices".

4.22 Polished parts

4.22.1 Maintenance

Clean polished parts and spray with anti-corrosion oil	
Interval	once per week

Polished parts of all kinds must always be kept clean.

Caution!

The machine tool and its related equipment and accessory may not be cleaned with compressed air.

Otherwise, dirt particles and chips may be introduced to the guideways thus affecting the accuracy of the machine tool.

Note!

Chips may be removed using and insustrial vacuum cleaner. Then, wipe clean the machine tool using a cloth.

After each cleaning, spray anticorrosion oil on the polished parts.

4.23 Poly-carbonate screens

4.23.1 Maintenance

Check poly-carbonate screens and replace, if necessary	
Interval	once per week

Replace poly-carbonate screens	
Interval	every 2 years

Caution!

The polycarbonate screen installed in the enclosure door is a wear part and must be replaced for safety reasons every 2 years. If the polycarbonate screen shows mechanical damage (white or dull, cracks or dents) before the expiration of this period, it must be immediately replaced.

Caution!

Polycarbonate screens with retaining function should be replaced after the specified interval in accordance with the recommendation VDW code of practice (version 4.5 dated 15th of August 2000).

Poly-carbonate screens subject to coolant or cooling lubricants over some time show aging, i.e. a deterioration of the mechanical characteristics. This leads to a reduced mechanical retaining capacity which may – under certain circumstances – lead to serious injuries.

FEHLMANN AG recommends to check screens from poly-carbonate for the following changes and immediately replace the glass if necessary:

- plastic deformation (buckling) through previous impact
- cracks
- damaged sealing at the edges
- destroyed or damaged poly-carbonate screens and PET foils

Caution!

The poly-carbonate screens must not be cleaned with solvent-containing cleaning agent.

The poly-carbonate screens are coated with a foil and may only be cleaned with a PET foil-compatible cleaning agent.

Note!

FEHLMANN AG uses well-dimensions and high-quality poly-carbonate screens. In accordance with the code of practice of the “Verein Deutscher Werkzeugmaschinenfabriken” (VDW – version 4.5 dated 15th of August 2000 – ageing aspects of poly-carbonate screens and machining tools), poly-carbonate screens must be considered wear parts.

4.24 Maintenance

Danger!

Before starting any maintenance works, the machine tool must be secured against being switched on unintentionally.

Lock the main switch using a padlock.

Danger!

Repair and maintenance of the machine tool may only be carried out by authorised qualified personnel.

Note!

Operational safety, life and precision of the machine tool essentially depend on properly and duly executed maintenance.

Note!

With FEHLMANN products, you have opted for precision. Precision, however, requires cleanliness and tidiness.

Always keep the machine tool in a clean and impeccable condition.

As a higher productivity of a state-of-the-art machine tool and its accessory and attachments automatically puts higher demands on maintenance and service, FEHLMANN AG recommends to check and maintain FEHLMANN products using the following check-up. Due to the varying operating conditions, it cannot be specified in advance how often wear checks, inspection, maintenance or repair will be required. A proper inspection routine must be defined taking into consideration the actual operating conditions. The check-up includes time, checking and maintenance information for the normal use of the machine tool. ***See paragraph 4.25 Outline Check-up.***

Any malfunctions during the operation caused by the insufficient or improper maintenance of the machine, may lead to very high repair costs and long downtimes. Therefore, a regular maintenance is indispensable.

Furthermore, all spare or wear parts which cannot be delivered in the short term, should be kept on stock by the user. As a rule, production failures are more expensive than the costs for the part to be replaced.

If, for certain reasons, the replacement of parts is done by the user himself, the following regulations and information must be observed.

- If screws become defective and can no longer be used when dismounting parts, they must be replaced with screws of the same quality (stability, material) and type.
- You may use the maintenance check list to always keep yourself up to date as to the precise maintenance level of the machine. ***See paragraph 4.26 Maintenance check list.***

Note!

FEHLMANN AG has the right to reject warranty claims if there is no proof of the fact that the customer has serviced the system according to the operating instructions and – subject to the written permission of FEHLMANN AG – that replacement and wear parts not exclusively delivered by FEHLMANN AG are used.

4.25 Outline Check-up

Position	Interval	IM*	Activity
Safety devices -> 3.6.1.1	once per month	B	Checking the EMERGENCY STOP button
	once per month	B	Checking the work spindle for smooth running
Data back-up (option POSITIP 880) -> 4.3	after each change	D	Save configurations
	once per week	A	Save NC programs
Machine head -> 4.7	once per week	A	Re-lubricate lubricating points
Belt drive -> 4.10.3.1	once per year	C	Inspect the belt tension
Frequency converter FVR-E11S-4EN -> 4.14	–	D	Frequency converter (see supplementary folder "auxiliary devices")
Coordinate table (option) -> 4.16	once per month	B	Check dove tail guides and protective devices and clean them if necessary
	once per week	A	Re-lubricate dove tail guides
Fan control cabinet -> 4.17	once per month	B	Check the filter mat and blow out, if necessary
	once per year	C	Replace the filter mat
Coolant tank -> 4.18	once per week	A	Check coolant level and refresh/ replace, if necessary
Coolant -> 4.19	once per week	A	Check the concentration
	once per week	A	Check the pH value
	once per week	A	Check the germ number (microorganisms, bacteria, and fungi)
Centring magnifying glass (option) -> 4.20	–	D	Centring magnifying glass (see supplementary folder "auxiliary devices")
3D measuring probe system KT1xx (option) -> 4.21	–	D	3D measuring probe system (see supplementary folder "auxiliary devices")
Polished parts -> 4.22	once per week	A	Clean polished parts and spray with anti-corrosion oil
Poly-carbonate screens -> 4.23	once per week	A	Check poly-carbonate screens and replace, if necessary
	every 2 years	D	Replace poly-carbonate screens

* Interval of maintenance

4.25.1 Interval of maintenance A once per week

Position	**Interval**	**IM***	**Activity**
Data back-up (option POSITIP 880) -> 4.3	once per week	A	Save NC programs
Machine head -> 4.7	once per week	A	Re-lubricate lubricating points
Coordinate table (option) -> 4.16	once per week	A	Re-lubricate dove tail guides
Coolant tank -> 4.18	once per week	A	Check coolant level and refresh/ replace, if necessary
Coolant -> 4.19	once per week	A	Check the concentration
	once per week	A	Check the pH value
	once per week	A	Check the germ number (microorganisms, bacteria, and fungi)
Polished parts -> 4.22	once per week	A	Clean polished parts and spray with anti-corrosion oil
Poly-carbonate screens -> 4.23	once per week	A	Check poly-carbonate screens and replace, if necessary

* Interval of maintenance

4.25.2 Interval of maintenance B once per month

Position	**Interval**	**IM***	**Activity**
Safety devices -> 3.6.1.1	once per month	B	Checking the EMERGENCY STOP button
	once per month	B	Checking the work spindle for smooth running
Coordinate table (option) -> 4.16	once per month	B	Check dove tail guides and protective devices and clean them if necessary
Fan control cabinet -> 4.17	once per month	B	Check the filter mat and blow out, if necessary

* Interval of maintenance

4.25.3 Interval of maintenance C once per year

Position	Interval	IM*	Activity
Belt drive -> 4.10.3.1	once per year	C	Inspect the belt tension
Fan control cabinet -> 4.17	once per year	C	Replace the filter mat

* Interval of maintenance

4.25.4 Interval of maintenance D

Position	**Interval**	**IM***	**Activity**
Data back-up (option POSITIP 880) -> 4.3	after each change	D	Save configurations
Frequency converter FVR-E11S-4EN -> 4.14	–	D	Frequency converter (see supplementary folder "auxiliary devices")
Centring magnifying glass (option) -> 4.20	–	D	Centring magnifying glass (see supplementary folder "auxiliary devices")
3D measuring probe system KT1xx (option) -> 4.21	–	D	3D measuring probe system (see supplementary folder "auxiliary devices")
Poly-carbonate screens -> 4.23	every 2 years	D	Replace poly-carbonate screens

* Interval of maintenance

4.26 Maintenance check list

Copy the empty maintenance check list and fill in as appropriate.

Example – Maintenance check list

Machine type	Picomax 60-M
Machine no.	14501355
Interval	once per month
Activity	Checking the oil level and fill up if necessary

Date	Visum	Remarks
25.03.01	DSy	Oil filled up

Maintenance check list

Machine type	
Machine no.	
Interval	
Activity	

Date	**Visum**	**Remarks**

4.27 Lubricant comparison table

4.27.1 Oils

OILS - date September 2005

Product	**Slideway oil** ISO-VG 68 CGLP 68/DIN 51502	**Slideway oil** ISO-VG 32 CGLP 32/DIN 51502	**Hydraulic oil** ISO-VG 32 HLP 32/DIN 51524 T.2
Agip	Exidia 68	Exidia 32	OSO 32
Aral	Deganit BWX 68	Vitam DE 32	Vitam DE 32
Aseol	16-42 Topslide A68	16-41 Topslide A32	15-525 Drolik 32
Avia	AVIA GLEITBAHNÖL RSU 68	AVIA GLEITBAHNÖL RSU 32	AVIA FLUID HLPD 32
Blaser	BLASOL 743	BLASOL 741	BLASOL 157
BP	Maccurat 68D	Maccurat 32D	Energol HLP-HM32
Castrol	Magnaglide D 68	Magnaglide D 32	Hyspin AWS 32
Elf	HYGLISS 68 / MOGLIA 68	HYGLISS 32	ELFOLNA DS 32
Esso	FEBIS K 68	FEBIS K 32	NUTO H 32
***Mobil**	Vactra Oil No. 2	Vactra Oil No. 1	DTE 24
Motorex	Supergliss 68 K	Supergliss 32 K	Corex HLP-D 32
Shell	Tonna S Oil 68	Tonna S Oil 32	Tellus Oil 32

or other products of identical specification – subject to product changes.

*Initial filling at the factory

Caution!

Only products listed in the lubricant comparison table may be used.

4.27.2 Grease

GREASE - date September 2005

Product	**Grease** KP 2 G-20 /DIN 51502	
Agip	Longtime Grease 2	
Aral	Aralub HLP 2	
BP	Energrease LS-EP 2	
DEA	Glissando R EP 2 LF	
Esso	Beacon EP 2	
Fuchs-DEA	Renolit MP	
Klüber	Centoplex 2	
Mobil	Mobilux EP 2	
Optimol	Longtime PD 2	
***Shell**	Alvania 2	

or other products of identical specification – subject to product changes.

*Initial lubrication at the factory

Caution!

Only products listed in the lubricant comparison table may be used.

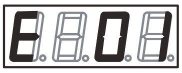
5 Error messages

5.1 Preface

The machine tool is equipped with a minimum monitoring system which shows error numbers on the digital display.

5.2 Error messages on the digital display

If errors are displayed when working with a machine tool, they are displayed as follows on the digital display of the machine control panel:

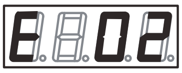


Cause

This error message is displayed when the EMERGENCY OFF button has been pressed or if the spindle motor has an overtemperature. The latter is also displayed by an LED which illuminates in red and which is in the electric cabinet on the print directly next to the relay.

Removal

- Unlock the EMERGENCY OFF button and press the control voltage ON key
- Check the motor PTC thermistor



Cause

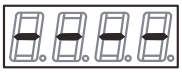
Overload or malfunction of the frequency converter

Removal

- Actuate the EMERGENCY OFF button, wait for 20 seconds, unlock the EMERGENCY OFF button and press the control voltage ON key

If this error message is displayed various times, the digital display of the frequency converter itself displays an error message.

For detailed information, see supplementary folder "Auxiliary devices".



Cause

The centring magnifying glass illuminates. Due to this, the spindle interrupt has been activated.

Removal

- Actuate the centring magnifying glass key again

6 Spare parts and customer service

6.1 Spare parts and customer service

Danger!

The due function and safety of the product can only be guaranteed if you use the original spare parts delivered by FEHLMANN AG. FEHLMANN AG cannot be held liable for any damage caused by the disregard of this instruction.

For ordering spare parts, please use the spare part list as well as the parts lists in the appendix.

Please note that often special manufacturing and delivery specifications exist for original and supplied parts so that they are always matched to the latest state-of-the-art and legal regulations.

When ordering spare parts, please specify the following data:

Company information

- Company address
- Internal company order no.
- Delivery address
- Invoice address
- Person responsible for possible questions

Order information

- Serial number of the machine tool or the accessory
- Type designation of the machine or the accessory
- Article no. with designation
- Number of pieces
- Type no./storehouse no. (possibly order no.)

Spare part and customer service	
Direct phone number of our customer service: Phone +41 62 769 12 80 Telefax +41 62 769 11 93 E-mail: service@fehlmann.com	**FEHLMANN AG, Maschinenfabrik CH-5703 Seon:** Phone +41 62 769 11 11 Telefax +41 62 769 11 90 E-mail: mail@fehlmann.com

7 Specifications

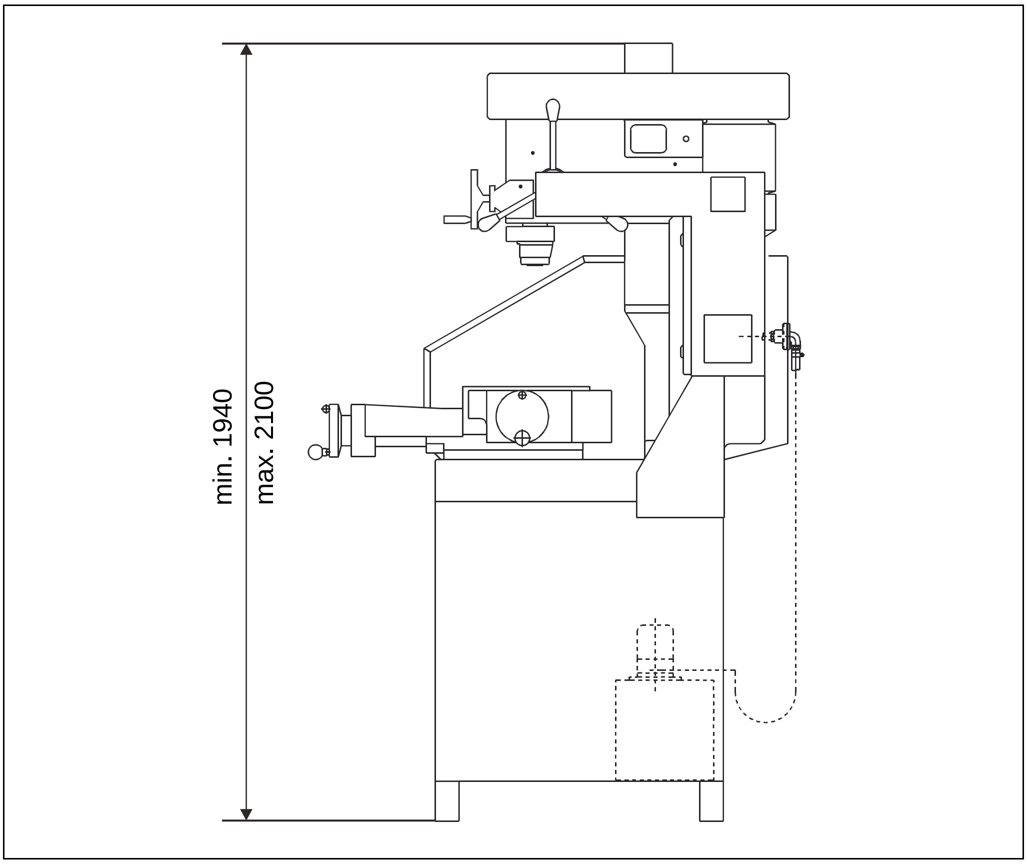
7.1 Mechanical specifications

7.1.1 Dimensions/space requirement/weights

Height machine tool (for the standard model)		
– min. – max.	m	1.94 2.10

Transport height machine tool		
For the standard model (on pallet, with ring bolt)	m	2.15

Installation diagram

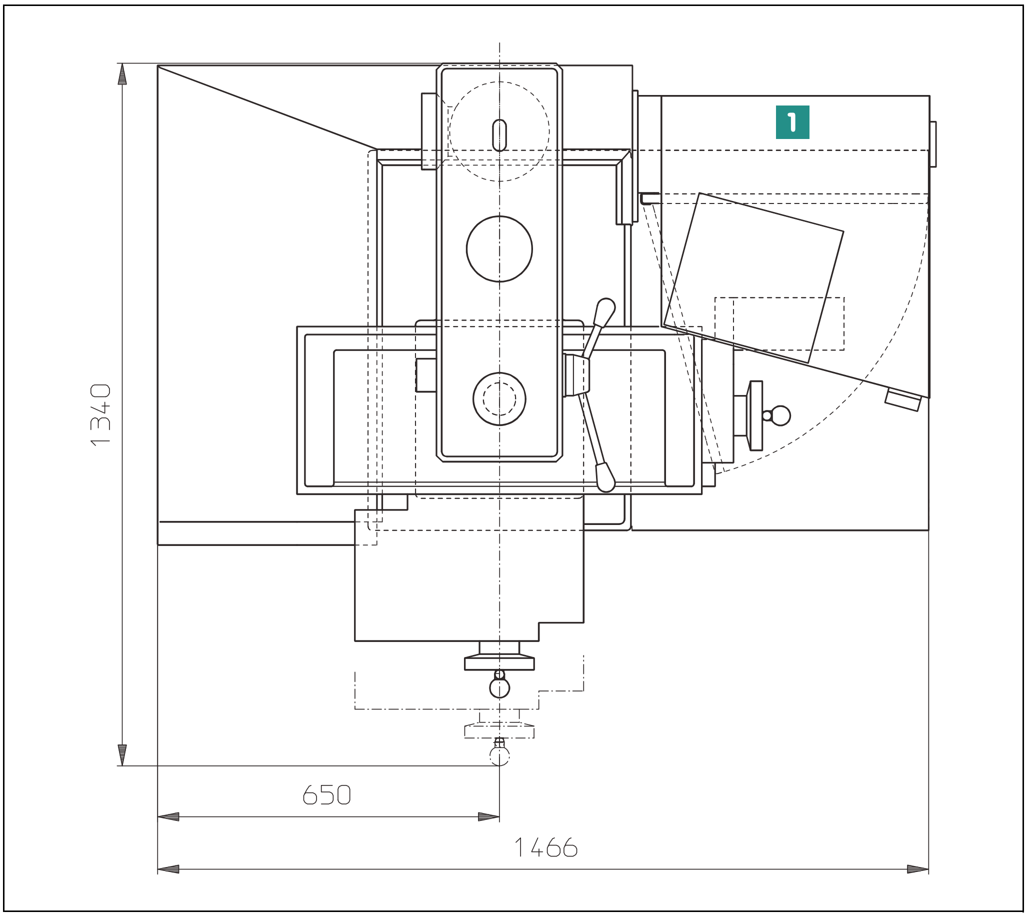


7.1.1.1 Machine tool

Dimensions/space requirement/weights		
Dimensions (width x depth)	m	approx. 1.47 x 1.34
Space requirement (width x depth)	m	approx. 1.47 x 1.34
Weight machine tool	kg	approx. 895
Weight coolant tank, empty / full	kg	approx. 13 / 33

Installation diagram

1 Connections:
– pneumatic
– electrical



7.1.2 Operating range

Traveling parts		
Z or quill travel manual	mm	110
Machine head travel	mm	450

Feed rates		
Z or quill feed rate	mm/min	manual
Machine head feed rate	mm/min	manual

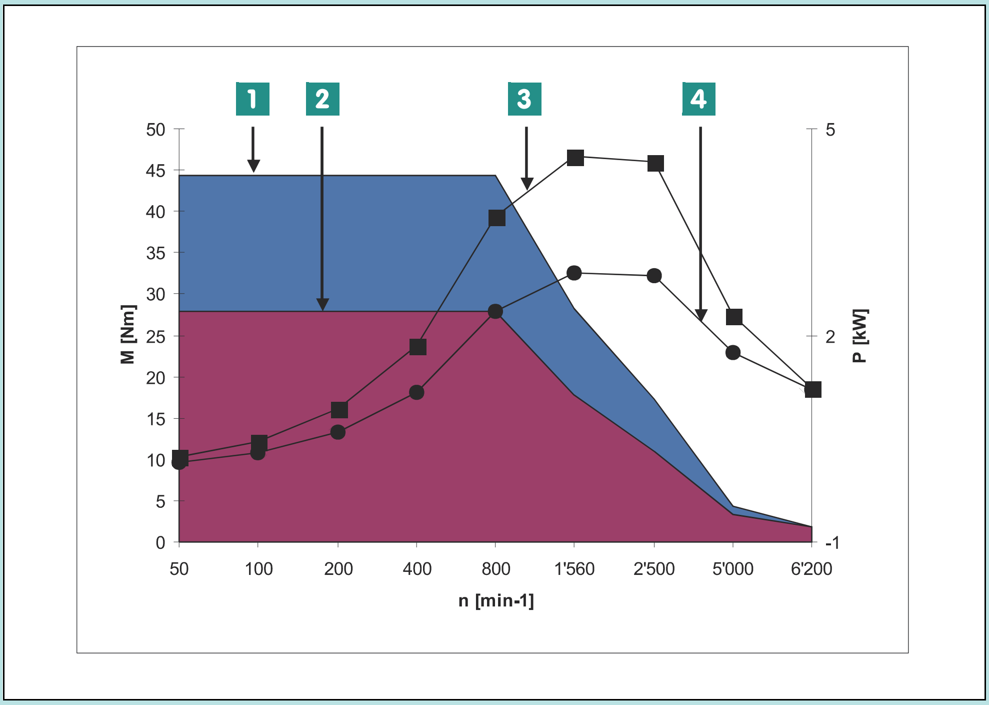
Driving forces		
X driving force	N	manual
Y driving force	N	manual
Z or quill driving force	N	manual

Table/machining area		
Clamping surface (Length x width)	mm	320x340
Distance floor – base plate	mm	895
Distance base plate – Spindle nose	mm	145–255–705
Horizontal projection	mm	267

7.1.2.1 Work area coordinate table (option)

For detailed information, see operating and maintenance manual of the coordinate table.

7.1.3 Work spindle

Power/torque		
Tool reception	–	SF32
Tool holder	–	SF32
Clamping pin	–	–
Repeatability	mm	0.002
Speed range	rpm	50–6300
Output at S1 (100% d.c.)	kW	2.9
Output at S6 (40% d.c.)	kW	4.6
Nominal rated speed	rpm	990
Max. torque at S1 and rated speed	Nm	28.0
Max. torque at S6 and rated speed		44.4
Spindle speed output diagram 		

1 Torque at S6
2 Torque at S1
3 Output at S6 (40% d.c.)
4 Output at S1 (100% d.c.)

Machining efficiency (Steel 700N/mm^2)		
Max. drilling power	mm	ø 25
Thread cutting	–	M20

7.1.4 Position display (option)

7.1.4.1 Positions display ND 780

Position display ND 780		
Type	–	ND 780
FEHLMANN order number	–	E5217-078-00

7.1.4.2 Positions display POSITIP 880

Position display POSITIP 880		
Type	–	POSITIP 880
FEHLMANN order number	–	E5217-880-00

D Sub cable to POSITIP 880		
Type	–	VB, PT 880/IOB 810
FEHLMANN order number	–	E5217-880-90

In- and Output module to POSITIP 880		
Type	–	IOB 810
FEHLMANN order number	–	E5217-880-20

7.1.5 Safety device

Poly-carbonate glass for safety device		
Type	–	Poly-carbonate glass with metal frame for P20
FEHLMANN order number	–	E5892-989-01

7.2 Electrical specifications

7.2.1 Residual-current protective devices (option)

See paragraph 3.5 Commissioning works - electrical wiring.

Residual-current protective devices		
Type	–	FIK4 (30mA)
or		
Type	–	5SZ

7.2.2 Machine tool

Power supply specifications		
Operating voltage and frequency	V/Hz	3 x 400/50
Connected load	kW	4
Max. back-up fuse	A	16AT
Control voltage	V	24 DC
EMP fault liability	–	EN 50081-2 EN 50082-2
Radio interference degree	–	EN 55011 class A
Max. permissible rated frequency fluctuations	%	±1 continuously ±2 briefly
Max. permissible rated voltage fluctuations	%	±10

Caution!

Voltage fluctuations at the amchine tool may not exceed the defined tolerance values of ±10 %.

Should the voltage fluctuations exceed these values, a voltage stabilizer must be connected in series with the machine.

7.3 Max. permissible environmental conditions

Environmental operating conditions for accuracy machining

Temperature/humidity/installation height		
Max. permissible environmental temperature	°C	+15 to +35
Temperature gradient	°C/h	0.2
Humidity (without condensation)	%	20–75
Max. installation height	M. S. L.	1000

Environmental operation conditions for high-accuracy machining

Temperature/humidity/installation height		
Max. permissible environmental temperature	°C	+21 to +23
Temperature gradient	°C/h	0.2
Humidity (without condensation)	%	20–75
Max. installation height	M. S. L.	1000

Note!

FEHLMANN AG cannot be held liable for any damage caused by exceeding the max. permissible environmental operating conditions.

7.4 Noise emission

Measured airborne noise emissions as per EN ISO 3746		
Emissions sound pressure level (L_P)	dB (A)	73
Sound power level (L_W)	dB (A)	86
Measurement uncertainty (K)	dB (A)	4